FLIGHT, OCTOBER 20, 1938 FIRST AERO WEEKLY IN THE WORLD REGD. AT THE G.P.O. AS A NEWSPAPER

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The AIRCRAFT ENGINEER AND AIRSHIPS

No. 1858 Vol. XXXIV

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

Reorganising the Air Ministry

ALTHOUGH the official announcement had not been published when *Flight* went to press this week, those in close touch with the Air Ministry have known for some time that considerable reorganisation is taking place in the technical departments.

A beginning was made last June, when Mr. E. J. H. Lemon was appointed Director-General of Production and given a seat on the Air Council. At the same time, too, the Directorate of Aeronautical Production was transferred from the Department of the Air Member for Supply and Organisation to that of the Air Member for Research and Development.

When the Cadman Report thought fit to criticise the system of having serving officers as heads of the technical departments of the Air Ministry, *Flight* more than once expressed the view that the committee came very close to putting its finger on the right spot, but pointed out that what was really needed was a reorganisation inside the technical departments, and that having officers occupying, somewhat transitorily, the posts at the head of the departments was not really the important thing.

Our words appear to have fallen on fruitful ground, and far-reaching reforms are in the offing. From being a sub-section of one department and then of another, the Directorate of Aeronautical Production will take its place among the other great departments, as befits that section of the Air Ministry which deals with what has come to be one of the most important aspects. Mr. Lemon will remain as Director-General, and the fact that he is a Member of the Air Council will ensure that production questions will receive the full attention which they deserve.

New Appointments

MOST startling of the changes in personnel is the transfer of Lt. Col. Outram from the post of Director of Aeronautical Inspection, a post which he has occupied from the very beginning of the A.I.D., to that of Director of Production (Aircraft). The success of the A.I.D. is in itself proof of Lt. Col. Outram's organising ability, and in his new post he will deal with the creative instead of with the purely examining side.

Immediately under him Lt. Col. Outram will have two men with long and distinguished service in the Department of the Air Member for Research and Development. Major J. S. Buchanan, for many years Deputy Director of Technical Development, will become Deputy Director (Aircraft), and Major G. P. Bulman, equally long Assistant Director (Engines), will become his opposite number as Deputy Director (Engines). Both are liked and respected by the aircraft industry, and their appointments will be greeted with general satisfaction.

One sphere in which this country lagged behind until, a year or so ago, a Directorate was established side by side with those of Technical Development and Scientific Research, is that of Armament. In the reorganised Air Ministry the post of Director of Production (Armament) will be occupied by Lt. Col. H. A. P. Disney, hitherto Director of Aeronautical Production.

That there will be other changes goes without saying. Some will be necessitated by the transfers and promotions outlined above; others may well be made in the national interest. The great thing is that the Air Ministry has climbed down from the attitude expressed at the time of the Cadman Committee Report, and, as we advocated, is setting its own house in order.

London's Balloons Ready

IT is very gratifying to be able to state that all the four hundred and fifty balloons, together with their mobile winches and trailers, which form the established equipment of the ten Balloon Barrage squadrons of the London area have been delivered by the makers. The fact that only a comparatively few balloons were sent up on the recent demonstration, was due to lack of trained crews, not to lack of equipment. As it was, the escape of some of the balloons pointed to insufficient training on the part of those who handled them. Such mistakes must be expected in newly formed units, and the public ought not to blame the Auxiliary airmen who had worked hard and had attained a very creditable degree of expertness in a very short time. More drills will soon give the men the necessary practice which leads to really smart handling.

It is, however, very obvious that more recruits are needed before all the four hundred and fifty balloons can be sent up at once over the London area. The authorities, in natural anxiety not to take able-bodied men who might serve in the Territorial Army or in the aeroplane branch of the Auxiliary Air Force, at first pitched the minimum age for B.B. airmen too high, at 38. It soon became obvious that enough men of that age could not be obtained, or at least could not be obtained quickly enough, and accordingly the minimum age has now been reduced to 25. It is very much to be hoped that the ten squadrons will soon be brought up to full strength in men as they already have been in *material*.

Still Room for Improvement

IT is a fairly common view in many quarters that in the matter of aerodynamic efficiency of aircraft we have gone just about as far as it is practicable to go unless and until we get the "all-wing" aircraft. In *Flight* of September 29, 1938, we published an article by Mr. R. M. Clarkson on speed efficiency. He arrived at the conclusion that the De Havilland Albatross is the most efficient aeroplane built so far.

Herr H. Eick, of the Deutsche Versuchsanstalt für Luftfahrt, has been looking into the same subject very thoroughly, and gives an account of his work in an interesting and instructive article in the last issue of *Luftfahrtforschung*.

Taking what is a fairly orthodox design nowadays (a twin-engined, low-wing cantilever monoplane with liquid-cooled engines, retractable undercarriage and twin rudders on the ends of the tailplane), and reducing the drag of individual components by every means known to science to-day, he arrives at a certain minimum drag coefficient, corresponding to a speed of 648 km/hr. (402.6 m.p.h.). Comparing this minimum drag with the drag of existing high-speed aeroplanes Herr Eick finds that these have minimum drags of the order of 45 per cent. to 55 per cent. of the theoretically attainable "all-time low," as our American friends would express it.

That is good news, for it shows that if we like to take enough trouble we can still improve our high-speed aeroplanes quite a bit. Translated into performance it means that if the minimum drag coefficient is reduced to what appears possible there will be a gain in maximum speed of approximately 25 per cent. And even if only 75 per cent. of the refinement is achieved there will still be a gain in maximum speed of something like 10 per cent. And even a gain of that order is worth having.

Production Figures

IT is stated that Gen. Vuillemin, Chief of the French Air Force, who has recently visited Germany, has reported that the latter country is now producing about eight hundred aircraft a month. In time of peace that is an impressive figure, and nobody claims that either the British or French industry has yet attained it, although what we shall do when all the new factories get into full production is another matter.

Nevertheless, that figure, if correct, is more imposing by comparison than in an absolute sense. It would not be sufficient to keep a large Air Force fully equipped in time of war. The matter is carefully examined by Mr. J. M. Spaight, C.B., C.B.E., in his latest book, *Air Power in the Next War*, which is reviewed on page *g* of this issue. He points out that at the end of 1918 Britain had a first-line strength of 3,300 machines, and in the ten months before the Armistice we produced nearly 27,000 aeroplanes and nearly 30,000 engines. In those days of wood and glue fewer man-hours were needed to produce a machine than are now necessary, and our object under Scheme L is a metropolitan strength of 2,370 and an overseas strength of 490, leaving the Fleet Air Arm out of account. It is probable that this programme will be increased and a new scheme drawn up. In fact, since the recent crisis both an increase and an acceleration are wanted.

We only hope that our French friends will also take adequate steps to press ahead.

Pro Focis et Aris

THE chief benefit which Germany obtained in the last war from her air raids on Britain was not the amount of material damage done or the number of civilians slaughtered but the holding up of work in factories when air-raid warnings were sounded. The increased power of aircraft means that in a future war there may be actual destruction of some factories as well as stoppage of work in others, and our armed forces may suffer grievously from shortage of munitions if that occurs. In fact, factories need special protection when enemy bombers are abroad.

It therefore seems a very good idea of the War Office to raise special anti-aircraft gun units among the workmen in various important factories. The gunners will always be on the spot, and their spells of duty in manning the guns will cause the least interference with the work. Every employee will feel that he is not left unprotected, but that the factory can hit back. That will give tremendous confidence.

Worth Developing

IT is a somewhat curious reflection that, in spite of the fact that we were among the first to develop the art of dropping and picking up messages by military aircraft, no attempt has been made to apply this useful activity to mails. It would seem that, as in so many other directions, we have left it to our good friends the Americans to put to commercial use something which originally began as purely a service activity.

In the Commercial Aviation section of *Flight* this week reference is made to these American experiments. The idea is that certain towns in the United States which have no aerodromes are to be given the benefits of the air mail service by employing specially equipped aeroplanes for dropping and picking up air-mail bags at points close to the outskirts of the towns. The delay caused to the mailplane will not be great; merely the

DIARY OF FORTHCOMING EVENTS—PAGE 347

THE ANVIL AND THE GLADIATORS : A unique aerial impression of the famous "tied-together" Gloster Gladiators of No. 87 (F.) Squadron before a perfect example of cumulo-nimbus cloud.

time taken to slow down for the operation of dropping or picking up the mailbag and for climbing to the operational height again.

It is possible to visualise the application of that idea to certain sections of the Empire air routes. Obviously not all are suitable, but a careful survey is well worth while, and there must be a great many townships in Africa and Australia, for example, where the preparation of aerodromes would be too costly in proportion to the volume of mails which leave and arrive, yet would benefit greatly from the speeding-up which a non-landing air-mail scheme would give.

So far as we are aware, experiments have never been made with picking up messages by seaplanes or flying boats. Certain fairly obvious difficulties present themselves, but it should not be impossible to fasten the posts to rubber buoys of the type which the late Mr. Eustace Short did so much to develop.

Mr. A. H. R. Fedden, designer of the Perseus, receiving from Maj. Gen. Ernst Udet the Lilienthal Ring—a high honour—during last week's Lilienthal congress in Berlin.

THE CIVIL RA

New Sleeve-valve Unit Completes Strenuous Endura Power for the New Shorts

The controllable warm- and cold-air intake is one feature apparent in this view of the Perseus XIIC.

AMONG the new civil aircraft to be fitted with the new Bristol Perseus civil-rated sleeve-valve engine are the strengthened Empire flying boats and the new Burnelli type transport of Cunliffe-Owen Aircraft, Ltd.

The Bristol Company produced the new engine in accordance with their policy of developing special versions of their power plants for civil purposes as and when demanded.

The Perseus XIIC civil-rated engine has lately completed an endurance test lasting 260 hours, each 10-hour period including 10 minutes under maximum take-off conditions with the engine developing about 900 h.p. at 2,700 r.p.m. Most of the running, it is stated, was performed under conditions of extreme fuel economy, subjecting the vital working parts of the engine to very severe treatment due to the high flame temperatures attained in the cylinders. The final 10-hour period was devoted entirely to running under take-off conditions, and for 5 hours the engine was delivering its maximum power.

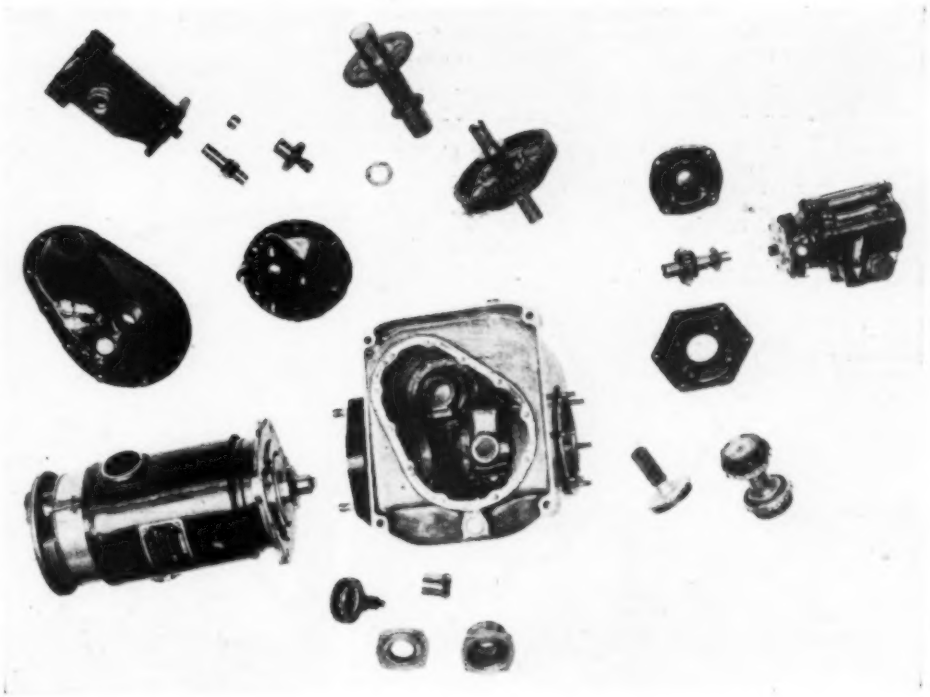
Actually, including incidental running, the engine was working for nearly 300 hours and is reported as having functioned very satisfactorily throughout. Absence of maintenance attention calls for special mention. When subsequently stripped for inspection it was found that the condition of the engine was notably good and augured well for the long life of the new unit.

The endurance test—on a standard production-type Perseus XIIC—was carried out under the supervision of Imperial Airways. Incidentally, the first of their new and improved Short flying boats is appropriately named *Cabot* after the Bristol mariner who discovered Newfoundland. *Cabot* is due shortly to make return flights between England and New York. This

The cylinder, sleeve, cylinder head, piston, connecting rod, gudgeon pin and wrist pin after test and before cleaning. Note the small deposit and excellent bearing surfaces

...RATED BRISTOL PERSEUS

...uous Endurance Test : New Shorts



The simple and compact accessory gear box with accessories before being cleaned after the arduous test.

class of boat is designed to operate at an all-up weight of 53,000 lb. with the aid of aerial refuelling. The original Empire boat, powered with four Bristol Pegasus XC engines, weighed 40,500 lb.

Considering its output, the Perseus XIIC is extremely compact. The capacity is under 25 litres, yet the maximum power available for level flight is 815 h.p. at 6,000ft. Under take-off conditions the unit delivers nearly 900 h.p. at the high crankshaft speed of 2,700 r.p.m.

A reduction gear ratio of 0.5 to 1 covers an extremely high torque at the airscrew for take-off. The use of a variable-pitch airscrew permits full advantage to be taken of this feature. Incidentally, the retention of the higher oil pressure now required in the airscrew hub for the operation of constant-speed mechanisms is ensured by a new internal oil seal in the airscrew shaft and induction gear assembly.

Complete with low-drag cowling, embodying controllable gills, the Perseus XIIC installation is only 53.15in. in diameter and 36.35in. in length from the leading edge to the end of the outlet gills. It is claimed that, due to the placing of the exhaust ring in the leading edge of the cowling, to the even cylinder temperature distribution and to the symmetrical shape of the sleeve-valve cylinder, permitting simple yet efficient baffling, the cooling characteristics are excellent.

Commercial operators will be particularly interested in the fully automatic carburation; exhaust-heated induction elbow; controllable warm- and cold-air intake; and automatic ignition timing control device, which ensures that the best ignition setting is obtained for every throttle opening including the extra advance required for cruising under conditions of maximum fuel economy.

The announcement of the strenuous tests of the new Perseus coincide happily with the award to Mr. A. H. R. Fedden, the designer, of the Lilienthal Ring. Mr. Fedden was also the recipient of the 1938 Guggenheim medal in recognition of his work in developing sleeve-valve aero engines.

Some new figures are given on page 334 for a new version of the small-diameter Aquila sleeve-valve engine, which is similar in many respects to the larger and more powerful Perseus.

The crankshaft halves, master connecting rod and big end floating bush, after the test and before cleaning.

THE LATEST

Important Data on New Military and Civil Types

APART from the new data for the Bristol Blenheim bomber, published on page 341, it is now possible to disclose some important and illuminating figures for other recent types of military and civil aircraft and engines.

The Hawker Hurricane eight-gun fighter is capable of 335 m.p.h. at 17,500ft.. climbs to 20,000ft. in 9 min. and lands at 62 m.p.h

The Armstrong Whitworth Whitley III bomber (A.W.38) when fitted with two Tiger VIII engines has the following characteristics : Cruising consumption (1,000 h.p. at 15,000ft.), 65 gal./hr.; weight empty, 15,750 lb.; weight loaded, 24,000 lb.; wing loading, 19.45 lb./sq. ft.; top speed at sea level, 185 m.p.h.; top speed at 15,000ft., 215 m.p.h.; normal cruising speed, 177 m.p.h. on 66 per cent. power at 15,000ft.; stalling speed, 59 m.p.h.; climb to 15,000ft., 23½ min.; service ceiling, 22,000ft.; standard range at cruising speed, 1,315 miles.

The price of the *Ensign* four-engined airliner is quoted at £52,000. Figures are: Top speed, 205 m.p.h. at 7,000ft.; maximum cruising speed, 170 m.p.h. on two-thirds power at 7,000ft.; climb to 10,000ft., 18 min.; service ceiling, 16,500ft.; range at cruising speed, 850 miles at 60 per cent. power.

The two-seater low-wing pusher monoplane to be produced by General Aircraft will be known as the Cagnet and will be powered with a 50 h.p. Pixie four-cylinder engine (née Weir) with fan cooling.

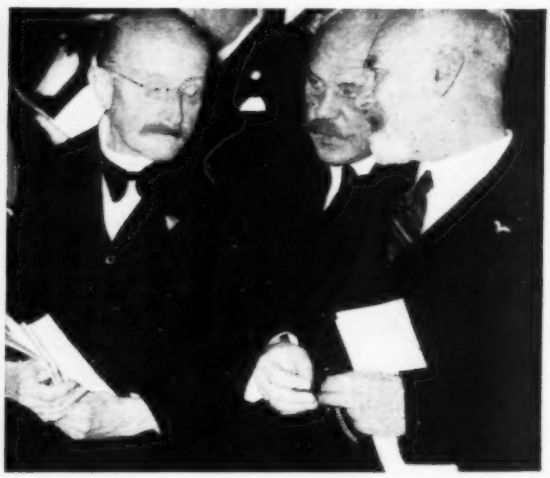
Among the new ultra-lights there is a version of the Chilton monoplane with 44 h.p. Train engine. Later it is hoped to fit a Cirrus Midget, making the machine highly suitable for aerobatics.

The Dart Weasel is a two-seater monoplane normally powered with the Cirrus Minor. The training version will have a tricycle undercarriage and a simple tail skid for heavy tail-down landings.

Prominent among the new engines is the Bristol Aquila IV sleeve-valve unit, which has the following characteristics: Bore and stroke, 5in. by 5⅝in.; cubic capacity, 950 cu. in.; reduction gear ratio, 0.5 to 1 ; diameter (over cyl. heads), 46in.; take-off (max.), 600 h.p. at 3,000 r.p.m.; international rating, 450/470 h.p. at 4,500ft. at 2,600 r.p.m.; max. level flight, 540 h.p. at 6,000ft., at 3,000 r.p.m.

The following new data for the two-speed supercharged Pegasus XVII and XVIII are announced: Take-off power at maximum take-off r.p.m., 965 h.p.; international rated power, in "M" gear, 780/815 h.p. at 4,750ft.; in "S" gear, 720/750 h.p. at 14,750ft.; maximum power for all-out level flight in "M" gear, 1,000 h.p. at 3,000ft.; in "S" gear, 885 h.p. at 15,500ft.

Ratings for the Alvis Leonides radial are: International power, 430 h.p.; maximum power, 440 h.p.; take-off power, 450 h.p. This engine operates on fuel of 87 octane number and weighs 680 lb.



AT THE LILIENTHAL CONGRESS, held last week in Berlin. Left to right: Gen. Milch, Gen. Porro (Italy), Mr. Wilson (American Ambassador), Maj. Gen. Udet, and Gen. Thomson. The close-up snap on the right shows Prof. Planck (Prussian Academy of Sciences) with (right) Prof. Prandtl of Lanchester-Prandtl aerofoil theory fame.

"AIRCRAFT PRODUCTION"

PUBLISHED by Iliffe and Sons, Ltd., *Aircraft Production*, No. 1 of which will be on sale next Wednesday, October 26, is the most recent technical journal to appear. This monthly publication will be the only one in the world devoted solely to the technical aspects of aero engine and aircraft manufacture.

The first issue, dated November, contains a message from the Air Minister, Sir Kingsley Wood, who says: "The considerable scale on which aircraft are now being constructed in Great Britain to keep pace with the demands of the Royal Air Force expansion scheme has made the present an opportune moment for launching a periodical intended especially to assist in the co-ordination of design and production of aircraft."

Features of the first issue will include a description of the Austin Shadow Factory, in which are produced Fairey Battle bombers; an article stressing the importance of co-operation between production and inspection, by Lt.-Col. H. W. S. Outram, C.B.E., the new Director of Production (Aircraft); a description of the manufacture of aircraft radiators; an article describing the spot-welding methods of a pioneer German firm; and descriptions of special French and American plant, as well as regular features which include a review of selected British and foreign machine tools, small tools and shop equipment.

Aircraft Production is a high-class, illustrated, technical journal printed on art paper. It will appear on the fourth Wednesday in each month, price 1s.; annual postal subscription rate 16s.; Canada 13s. 6d.

Vickers Aircraft Reorganisation

VICKERS, LTD. announce that the works and business of Vickers (Aviation), Ltd. and The Supermarine Aviation Works (Vickers), Ltd., are being taken over by Vickers-Armstrongs, Ltd. It is hoped that a detailed statement will be available in the near future.

Paris Aero Show Exhibitors

NINETEEN British firms will exhibit at the Paris Aero Show, which takes place from November 25 to December 11:—Blackburn Aeroplane Co.; Bristol Aeroplane Co.; De Havilland Aircraft Co.; Hawker Aircraft Co.; Armstrong Siddeley Motors, Ltd.; D. Napier and Son, Ltd.; Rolls-Royce, Ltd.; Rotol Airscrews, Ltd.; H. M. Hobson (Aircraft and Motor) Components, Ltd.; Gallay, Ltd.; Aircraft Components, Ltd.; Cornercroft, Ltd.; Dunlop Rubber Co., Ltd.; High Duty Alloys, Ltd.; Lodge Plugs, Ltd.; Short and Mason, Ltd.; Smith's Aircraft Instruments; Standard Telephone and Cables, Ltd.; and Williamson Manufacturing Co., Ltd.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

THE COMPOSITE INFLUENCE—or just a photographic coincidence. Two Short boats, Qantas Empire Airways' *Coogee* and Imperial Airways' *Corsair*, riding at anchor in choppy water in Rose Bay, Sydney.

A TRAIN of no fewer than nine gliders was, it is reported, towed by an aeroplane at an "Aviation Day" display at the Tushino Aerodrome, Moscow.

In addition to the $18,000,000 order for 200 aircraft for the British Government, the Lockheed Aircraft Corporation has just contracted for a further order to supply spare parts valued at $3,900,000.

Weather, coupled with difficulties concerning the C. of A. of his Mew Gull, have combined to delay the departure of Alex. Henshaw on his attempt on the London-Cape Town record. He must now wait until the next full moon.

The Duke and Duchess of Gloucester are due back in London on November 10 or 11, on their return from Kenya. The Duke and Duchess will fly from Uganda to Cairo, before catching a liner to Marseilles. From there they will fly back to England in the Air Council's De Havilland D.H.86B.

The Royal Aeronautical Society's gold medal was presented by Sir Nevile Henderson to Dr. Eckener, of Zeppelin fame. Mr. A. H. R. Fedden, designer of the Bristol Perseus engine, has been awarded the Lilienthal Ring. Both presentations were made during the Lilienthal Congress at Potsdam.

Twenty-five Years Ago

(From "Flight" of October 11, 1913.)

"Experiments have recently been carried out at Rheims with a quick-firing gun mounted on an aeroplane. The target consisted of the wings and fuselage of an old aeroplane, which was, at the conclusion of the test, riddled with bullets. The trials are to be continued, probably with a moving target."

Losses of £95,000 in 1937 and over £74,000 for the first half of 1938 on the Pan-American trans-Pacific mail and passenger service were revealed at a New York inquiry last week.

Last Saturday, Captain Alexander Papana, of the Rumanian Air Force, flew from New York to Miami on the first stage of his flight to Bucharest, *via* Brazil and Dakar, Africa. The machine he is using is probably a Barkley-Grow twin-engined, low-wing monoplane.

A memorial window to the Duchess of Bedford was unveiled at Woburn Church last Sunday. The ceremony was performed in the presence of a large attendance by the Archdeacon of Bedford.

Captain D. O. Lumley, O.B.E., is to deliver the Brancker Memorial Lecture of the Institute of Transport, at 6 p.m. on November 29, at the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2. His subject will be "The Development of Air Mail."

MARSHAL OF THE ROYAL AIR FORCE SIR JOHN SALMOND inspecting cadets at the opening of new local headquarters of the Air Defence Cadet Corps at Watford last Saturday.

COMMERCIAL AVIATION

SUMMER AT SCHIPHOL: A glimpse from the windows of the restaurant and waiting room at Amsterdam's airport. At times there are as many as half a dozen Douglases lined up on the apron.

"*Flight*" photograph.

THE WEEK AT CROYDON

"A. Viator," Discoursing on Air Transport Matters, Deals with Guns, Wild Birds, Birthdays and the Quaint Effects of High Altitude

I WAS amused and possibly a trifle elated to see a letter in one of the newspapers from one who had written bitterly in the past about the hateful presence of commercial aircraft in our skies. He took back all he had said, and more or less promised not to grumble in future, for he had realised that it was a commercial aeroplane from the fleet of British Airways which saved the situation during the crisis.

London, I understand from one of the newspapers, was defended during the crisis by 100 obsolete guns, fifty of which lacked essential parts, such as button B, by which a gunner gets his shell back after a misfire. It sets one wondering how they armed our gunner subaltern who roosted on the airport edge so gallantly with his white tent camouflaged with an olive branch. Long Tom from Ladysmith would be too up to date for anyone less than a major, so I suppose he had a flintlock without the flint, or a matchlock with no matches.

Looking at our amusing trench system (in which it is reported that Works and Bricks mean to grow mushrooms, but up to date have only succeeded in raising livid looking fungi with scarlet spots) and narrowly observing our A.R.P. (which gives me far, far less confidence than a single I.P.A.) I am inclined to rejoice that we are apparently going in for total disarmament. A notice has just come to say that our signal bomb store is to be removed and the guns dismantled. So, for the time being, if you want guiding in during fog you will not get those jolly "golden rain" pyrotechnics which so frequently and so narrowly miss knocking your wing off.

Roosting

Talking of guns, this is the time of year when, saving the presence of Agriculture and Fisheries, but for the Wild Birds Protection Act and despite the obvious intention of the authorities to turn our airport into a bird sanctuary (in a different sense, of course, to the old Empire Promenade), it would be a good thing if a spot of gunning or bird scaring could be done. Birds tend to gather in flocks and fly round in dense masses at this time of year and constitute a definite danger to machines taking off and landing. The authorities will do nothing, though photographs have been sent to them of damage done to machines by collision with birds—there are cases on record of birds crashing through windows into cockpits. At night, ground roosting birds, gulls, plovers and so forth, get disturbed by searchlights and fly aimlessly around.

Let us hope that the gentle ornithologists at the Air Ministry will not put up bird tables and baths around the place to welcome and encourage heavier-calibre feathered friends of man, such as the great auk—no, no, *not* 'awk—the emu, the bustard, the booby and the dodo. The last two are generally thought to be rare if not extinct, but they say there is a dodo nesting on the roof of the Air Ministry, and as for boobies—well, don't let's go into that, it's scarcely fair.

Capt. O. P. Jones, of Imperial Airways, celebrated his fourtieth birthday last week and at the same time the twenty-first anniversary of his first flight. Capt. Jones has, during these years, flown forty-five different types of aircraft, from a 15 h.p. power glider to his latest mount, the 3,240 h.p. *Ensign*. He has flown 1,200,000 miles, has carried 96,000 passengers, and has crossed the English Channel 6,000 times. Complete records of his flights have required seventeen log books.

In the meantime, the K.L.M. Amsterdam-Batavia service has just celebrated its tenth birthday. During the decade, the travel time has been shortened by a third, the speed has been practically doubled, the load has become three times as great, and the frequency has become six times as great—and, incidentally, in these days it connects England with Australia as well as Amsterdam with Batavia. The England-Australia service is, of course, a partnership between the K.N.I.L.M. (Royal Netherlands Indies Air Lines) and K.L.M. (the Royal Dutch Air Lines).

Honesty Compels . . .

Last week I was boosting overweather flying as a form of transport envied by surface-creeping vehicles and practically without disadvantages to the traveller. Honesty compels me to give to the poor folk in charge of trains and boats and such the following facts to cheer them.

Very high flying not only exhilarates the traveller, but gives no end of uplift to the corks and stoppers of scent and brilliantine bottles. Change of pressure is apt, too, to raise dormant literary ambitions in your fountain pen, so that it writes things lavishly, if obscurely, on your shirt.

Worst tragedy of all, the drop of bottled sunshine you hope the Customs won't notice between the shirts and winter pants in your suitcase is apt to burst its bounds and saturate your kit. Strong drink (at 12s. 6d. a bottle) is a mockery when it is absorbed into the thirsty warp and woof of your dress suit, and if you are going to address a temperance meeting that evening, you will be sunk and may as well change your lecture into "Distilleries I Have Known."

Stewards aboard airliners have similar difficulties with their stocks of drink, and one of the first things a new steward learns is that a small bottle of bubbly, opened in a carefree manner, not only stuns the customer with the cork, but disperses its whole contents in a fine spray around the cabin. Train and boat stewards do not labour under the same problems. Bottles, despite the jolting which tends to turn a bottle of red wine into an oatmeal stout, open languidly—like Kaffirs on the Stock Exchange.

NEXT WEEK: FLIGHT BRITISH AIRCRAFT INDUSTRY

COMMERCIAL AVIATION (CONTINUED) : WORLD NEWS

Potez Fighter for Air Bleu

THE French Air Ministry has entrusted Air Bleu with one of the new Potez 63 twin-engined fighter-bombers which are powered with two small-diameter Hispano-Suiza two-row radials of 650 h.p. each. This type is capable of over 280 m.p.h. and is now going into service on a large scale. Presumably the Air Ministry is desirous of studying the behaviour of the machine when subjected to exacting conditions along the mail routes.

Twice Weekly to the Congo

AFTER the end of this month the frequency of the services to the Belgian Congo operated by Sabena and Air Afrique will be increased to twice weekly. At first the schedule will be operated with two departures each week by the same company, but, later on, alternate departures will be arranged.

The introduction of Sabena's new Savoia-Marchetti S.83 machines, which carry eight passengers at a maximum speed of 225 m.p.h., will enable this company to reduce the time for the service by one day in each direction. Leopoldville and Stanleyville will therefore be reached in four days from Brussels. After November 1 the Sabena service will be duplicated as far as Leopoldville, together with the Elizabethville and Stanleyville connections, while Air Afrique will be duplicated on the service as far as Brazzaville, the Elizabethville connection in this case remaining on a once a week basis. The Elizabethville-Tananarive (Madagascar) service will continue to be operated according to the old schedule.

Developing the S.E.200

THE first series of wind tunnel tests has just been completed, at Chalais-Meudon, of the model of the 66-ton transatlantic S.E.200 flying boat, which is being built by the Société Nationale des Constructions Aeriennes du Sud Est for Air France-Transatlantique.

It is said that the tests, which were for aerodynamic qualities and stability, were successful beyond expectations, but certain minor modifications are to be carried out before the second series of wind tunnels tests is started. The S.E.200, formerly known as the Lioré et Olivier 49, is the 66-ton flying boat derived from the LeO47, five of which, accommodating four passengers and a crew of four, will be ready for service on Air France's South Atlantic line next spring. It is, of course, much larger than the LeO47, which is 17 tons in weight, being equipped to carry 20 passengers and 8 crew as well as mails and freight across the North Atlantic. Its estimated top speed is 245 m.p.h. and cruising speed 200 m.p.h., and its range is 3,750 miles against a head wind of 37½ m.p.h. The model is fitted with six 32 h.p. electric motors to simulate the six engines totalling 9,000 h.p. of the full-sized boat in which the passengers' amenities will be remarkably complete.

Pick-up Mails

BY way of providing air mail facilities for towns and cities which have no aerodromes, or which are not considered to be sufficiently important as regular stopping places on an air service, an air-mail "pick-up" system is to be tried out in America. A new company, known as All-American Aviation Inc. of Morgantown, West Virginia, has ordered a fleet of specially equipped Stinson Reliants which will cover two new mail routes recently advertised by the Post Office Department. These two routes are from Philadelphia to Pittsburg, via twenty-four intermediate cities, and from Pittsburg to Clarksburg and Huntington, via twenty-eight intermediate cities. Altogether, fifty-six cities and towns in Pennsylvania and West Virginia will be served.

The Reliants will incorporate a special mail "pick-up" device, evolved by Dr. Lytle S. Adams, as part of their basic design. Mail to be dealt with will, on the ground, be attached to a rope strung across the tops of two posts. The machine will fly low and a grappling hook, trailing sixty-five feet behind, takes the rope and the mail, which is drawn into the machine by means of a winch. The return mails are presumably dropped by parachute, and the whole thing resembles the means by which Army co-operation machines pick up and drop supplies over here.

Apparently, experience has shown that the Adams system permits the picking up of the most fragile items without damage, since there is a shock-absorbing mechanism built into the device. A special Bill was passed at Congress last session authorising this mail "pick-up" service, and funds were appropriated to put the scheme into use.

New Equipment for Tatas

ONE of Qantas Empire Airways' D.H.86s, which has been purchased by the Tata Company of Bombay, has already flown to India by easy stages. It will probably be employed to take the heavy mail loads which are now being carried on the Bombay-Karachi route. This load reaches a very high peak on certain days, and the 86 should be extremely useful.

D/F Training

IN spite of the complete importance of direction-finding radio, and, more particularly, blind-approach beams, in transport flying, it is still difficult for pilots to find means for the necessary operational practice except in actual service. In the normal course of events the pilots of suitably equipped machines can obtain experience of blind-approach work by using their receivers when arriving in fine weather (rather after the fashion in which less advanced pilots make every aerodrome landing a forced landing), but fast work on a series of QDMs is another matter.

Although Hamble is still waiting for its Lorenz equipment—the delivery of which is subject both to more immediate Service and civil demands as well as to the difficulties of jamming—Air Service Training now has a Marconi-Adcock ground station in use, and six multi-engined machines have been fitted with their own D/F equipment. For some time the school has had its own wireless section, and the installation of the D/F equipment by the pupils must have given them very useful experience.

The ground Adcock system, which is arranged near the south-east corner of the aerodrome, is of the short-wave type, and the receiver covers the waveband between 15 and 220 metres. The actual wavelength which is normally used is in the vicinity of 190 metres, for the use of which frequency special permission has been obtained. The operator works in a hut between the four vertical aerials, and he is in position there to control the main transmitter through a system of relays. He can thus maintain constant two-way communication with the school machines while providing bearings where these are necessary. Some of the machines, incidentally, are fitted with equipment covering both medium- and short-wave bands, so that the operators can also make use of the civil stations, particularly when they are out on navigation work with the Service pupils who are now going through Hamble.

Provincial Terminals

RINGWAY, Manchester's new airport, is now in full working order under the management of Mr. Hill. Within a few weeks flood-lighting equipment will be installed by the General Electric Company and some of the Chance boundary lights, as well as the marker lights and wind tee, have already been put down.

In the course of the lighting development cables have also been laid down for the Lorenz blind approach beacon and for one of the necessary marker beacons, but it is not yet certain when this ultra-short-wave equipment will be available. The latest of these beacons to be installed, incidentally, is at Southampton, where the authorities have been waiting for this equipment for some time. Ringway is, nevertheless, a very important centre, and it seems probable that it will be the next on the list—subject, of course, to Service requirements.

When we described Ringway airport (in the issue of June 23, 1938) the special method for lighting the fog line was described, and this scheme, suggested by Norman and Dawbarn, should be working this winter in a somewhat simplified form. Short-range D/F equipment at Ringway is, of course, now being used, and the range has more recently been increased from that originally stipulated in order that Railway Air Services and K.L.M. machines may obtain bearings and pick up signals in good time. Incidentally, for their winter services from Amsterdam, K.L.M. are making Ringway their terminal, and do not call either at Doncaster or Liverpool. Apart from the convenience of such an arrangement for winter operations—when Doncaster and Liverpool are still available for emergency uses—practically all the traffic has, so far, it appears, come from the Manchester area.

With two airports of the sizes, respectively, of Ringway and Speke (Liverpool), nobody can deny that the North Midlands are very well served. Farther south, Birmingham's new airport at Elmdon is well on the way towards completion, though it is not likely to be in use before the early summer of 1939. The landing area is, however, already grassed, and work is now going on in the laying out of the circle and fog line.

Commercial Aviation

PRESENT-DAY TRANSPORT DEVELOPMENTS

—With Particular Reference to the New Curtiss-Wright "Twenty" : Some Original Opinions Expressed by the Corporation's Director of Engineering

IN describing the new Curtiss-Wright "20" transport, Mr. T. P. Wright, the Director of Engineering of the Curtiss-Wright Corporation, provides a number of interesting and even unusual sidelights on the design and operation of transport machines in general.

Before starting in on the design of this machine the Corporation had discussions with transport operators and came to the conclusion that a machine accommodating thirty passengers with a great degree of comfort and space would be best suited to take advantage of the often-given airline slogan "every hour on the hour." Having once flown in a large machine passengers become accustomed to its comfort and spaciousness and will not happily return to travel in a smaller type. On the other hand, whatever the frequency of schedule, a large percentage of the seating capacity must always, for economic reasons, be filled, and so the upper limits in size are clearly defined.

Plenty of Space

The new Curtiss-Wright has a fuselage in which the maximum possible amount of space for passengers is provided, while ample freight room is also offered. All mail, freight and baggage are carried under the floor of the passenger compartment, and this hold is accessible from the outside. An oval section of fuselage was decided upon largely because this form, by special structural design, made "pressurisation" for the passenger possible with the least expenditure of weight. The cross-section of fuselage is made, so to speak, of two circles which intersect at the floor position, the latter thus acting as a tension tie and withstanding any loads which are caused by the tendency under pressure of the two sections to separate. When the machine is cruising at 20,000ft. the structure is normally intended to take a pressure equivalent to that of the atmosphere at 6,500ft.; alternatively, at 11,000ft., sea-level pressure can comfortably be held.

It may be remembered from a previous drawing and short description in *Flight* (July 21, 1938), that the "20" is a twin-engined all-metal mid-wing monoplane powered with two Wright double-row Cyclones each with a take-off rating of 1,600 h.p. Any units up to 2,000 h.p. may, however, be fitted. The airscrews are of the Curtiss electric full-feathering, constant-speed type. The design gross weight is in the region of 36,000 lb., the span is 108ft. and the length is 76ft. According to estimates the maximum speed at 12,000ft. will be 237 m.p.h., the cruising speed at 10,000ft. will be 200 m.p.h. (or 210 m.p.h. at 20,000), and the landing speed will be 66 m.p.h. The single-engined ceiling is 14,800ft., and the take-off distance to surmount a 50ft. obstacle is given as 1,725ft.

The analysis of accident reports in 1936-37 shows that the causes were 31 per cent. personnel, 6 per cent. power-plant and 22 per cent. structural—19 per cent. of these failures being caused by undercarriage difficulties. The remaining 41 per cent. of the accidents were the result of bad weather and ground organisation defects. Since the human element is therefore the most important, the designer's job is to make the pilot's task as easy as possible, and simplification of his work has been stressed in the design of the Curtiss-Wright control cabin.

For instance the flying controls are power-servo assisted, and the Sperry automatic pilot is specially designed so that additional directional power is available to provide immediate rudder compensation in the event of the failure of one engine. Needless to say, special attention has been paid to the view for the crew, both in the air and on the ground, and with this object in view a special "clear vision," spokeless and centreless control wheel has been developed.

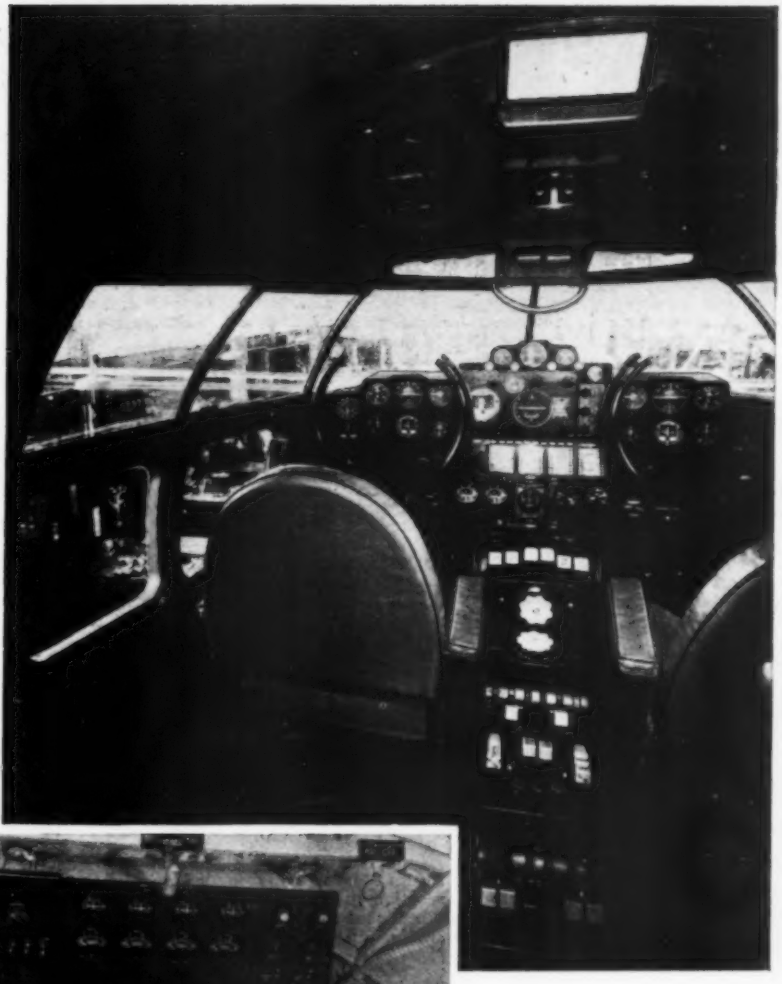
The instrument panel is arranged with tell-tale equipment to relieve the pilot of the need for constant checking, while the control cabin itself is, of course, under pressure with the rest of the fuselage while flying at high altitudes. In the matter of noise a decibel rating of 63 is expected. The entire cockpit has been designed by pilots for pilots, so that this is not only comfortable, but all controls are easily and conveniently accessible. A long series of wind tunnel tests have produced a design which should result in stability and good control co-ordination.

In the matter of stability the most important provision is that made to prevent the effects of wing tip stall which is existent in most taper-wing monoplanes, and has been the cause of several minor and major accidents to transport machines in the last year or two. In the Curtiss-Wright there is a gradual alteration in the wing section from root to tip, coupled with the use of moderate wash-out. A new form of slotted flap has been designed to give optimum landing and take-off flying qualities.

How Many Engines?

With the present tendency towards the four-engined type, the use of two large engines in the Curtiss-Wright demands some explanation. When making their decision the Curtiss-Wright engineers held the belief that for overland flying the use of more than two is not justified provided that single-engine emergencies can be dealt with. The need to allow for the possibility of failure during cruising flight is not the governing condition for normal transport, and the only risks involved are those at the moment of, or immediately after, the take-off. In the accident statistics a figure of only 6 per cent. is given for engine failure, and, apart from the previously mentioned Sperry pilot modification, the two engines in the "20" have full-feathering airscrews. These not only enhance single-engined performance, but also free the machine from the vibrations which may result from the wind-milling of a dead engine.

The statistics, again, show that the landing gear is the chief offender in the matter of structural failure, and in order to reduce the possibility of such failure the designers of the Curtiss-Wright have incorporated an extra-length oleo stroke, permitting a drop test to be withstood from a height of 42in.—a figure equivalent to a rate of descent of no less than 900 ft./min. The same margin of safety



Inside the control - cabin "mock-up" of the Curtiss-Wright transport. Two features are of particular interest. The first is the new type of "clear vision" control wheel, which has neither spokes nor centre; the second is the provision of additional windows, which may be seen on the left, to give the pilots a maximum range of vision. The instrument panel has an arrangement of tell-tales which relieve the pilot of the necessity for studying the individual readings of the instruments.

is provided in the case of the tail wheel. Additionally, the entire undercarriage has been placed well forward.

Both the choice of de-icing equipment and the shape of the leading edges of the control surfaces were determined after tests in a refrigerated wind tunnel. So that the risk of fire should be reduced to a minimum, the fuel tanks are located outboard of the engines, the only fuel entering the fuselage being that passing through one cross-feed line, which is constructed of heavy stainless steel. Incidentally, the low mid-wing arrangement was selected largely because of the greater hazard involved in a "tummy" landing

(*Cont. at foot of p.* 340.)

ORDERLY GROUPING: As a comparison with that of the new Curtiss-Wright, the control and instrument layout of the D.C.4 is shown on the left. Nowadays there is so much for the pilot and his assistant to look after that great pains must be taken to group the various items in order of precedence and to ensure that every one of the essential controls is immediately accessible.

On the power control bank, for instance, the section above is devoted to those controls and instruments which may be required continuously in actual flying, while below are grouped those which are only needed from time to time. In the centre of the dashboard is the Sperry automatic pilot panel with, on each side, a complete blind-flying group for each of the pilots. Above the screen, in the centre, are the various temperature and other indicators with most of the switch-gear. On their left are gauges measuring the actual horsepower delivered to the airscrews and the amount of hydraulic pressure available for braking.

Commercial Aviation

UP in the "ENSIGN"

A Passenger's Impressions

THE Press provided the first load of passengers for Imperial Airways' newly delivered Armstrong Whitworth *Ensign*—first of fourteen of her type for service on the European and Empire routes.

Foregathering at Croydon on Tuesday of last week we found her (not so easily as might be expected, for her proportions belie her size) occupied by amateur photographic models and servants of the company. The Avro Commodore on the tarmac signalled the presence of Flt. Lt. Turner-Hughes, the A.W. test pilot, who was discussing the bonny new baby with Captains Jones and Horsey. It was gathered that a number of Imperials' pilots have already been passed out on the machine and that two sister ships should be arriving almost immediately.

Unofficially one was told that the flying characteristics of the type are quite exemplary. Take-off, and more particularly landing, qualities are outstandingly pleasant for a machine of the *Ensign's* calibre.

Due to Imperial Airways' policy of standardisation of equipment, she is very reminiscent internally of an Empire boat, with the same dark green upholstery and the unique adjustable chairs. Her internal arrangements were illustrated in some detail in *Flight* of September 15.

The first machine is actually a twenty-seven-seater; in other words she is of the "Empire" type as opposed to the "European," though her preliminary runs will actually be made on the Paris route.

The take-off, with Captain Jones up front, took a shade under twenty seconds. On previous occasions she has unstuck with full load rather quicker. The wheels remained down until we were a few miles out of the aerodrome. Then the monster legs started to describe an arc and the mass of pipes and struts began to stow itself away in the nacelles. There was a somewhat disconcerting pause when the gear was raised about three-quarters of the way, which may have been due to the greater demands on the hydraulic system at that stage.

It is always difficult to assess noise levels, but one's first impression was that our cabin (under the wing) was a shade noiser than that of an Empire boat. The promenade deck is more or less in line with the airscrews and gets rather more decibels and vibration.

Ensign is certainly one of the most "solid" machines we know and, due, no doubt, to the high-wing layout, is very steady in the air. One was seated most of the time in one of the central seats, away from the windows, and was consequently handicapped in the matter of vision, but there seemed to be no evidence of yawing. Mr. Lloyd, the A. W. designer, seems to have made a single fin and rudder do the work of much more elaborate and unsightly foreign empennages.

The passengers, not knowing that Captain Jones had arranged to do a low fly-past for the cameramen, became distinctly restive as *Ensign* motored in over Purley Way with the wheels still snug in their nacelles. Actually the landing itself was the most perfect we have ever experienced. The flaps, by the way, were lowered only when the machine was a few feet from the ground.

Due largely to late delivery, for which her manufacturers are not to be blamed, the *Ensign* has been the object of some totally unjust criticisms. The truth is that, although the design is over four years old and consequently does not incorporate many of the benefits which characterise comparable machines on test abroad, the machine does great credit to her builders and operators.

State Interest in India

USING five aerodromes at Aurangabad, Bidar, Adilabad, Raichur and Devarkanda, the Hyderabad State authorities are shortly expected to start their own air transport services. This fact was mentioned recently by Major E. W. Slaughter, the general manager of the Nizam State Railway.

Earlier this year the railway administration took over the technical personnel, consisting of a qualified pilot and ground engineer, both of them Europeans, as well as the Hyderabad Aero Club's fleet of machines.

Tasman in January?

ACCORDING to reports, the air mail service connecting Sydney with New Zealand will start operations next January. In its earlier stages Auckland will be the New Zealand base for a twice-weekly service operated by two of the new high-payload Short boats. Later on, the route will cover a triangle linking Sydney, Auckland, and Wellington. The service will, of course, be flown by a company formed by Imperial Airways, Qantas Empire Airways, Union Airways, and the New Zealand Government.

In order to make a study of meteorological conditions over the route, an official of the Australian Meteorological Bureau is to travel to and fro across the Tasman Sea rather in the same way as one of our own meteorologists made a regular Atlantic crossing on the S.S. *Manchester Port* before and during the Atlantic experiments.

Present-Day Transport Developments

(*Continued from page 339*)

in the case of a machine of high-wing layout.

Economy of operation, of course, has been very carefully considered. Apart from the natural efforts to save structure weight, this demand has also contributed towards the decision to use the two large power units—a fact which also decreases the amount of drag and so aids economy. Drag is also reduced by a substantially complete flush riveting; by the elimination of carburettor and oil cooler scoops; by the use of special engine cowlings and flush window installation; by the complete retraction of the undercarriage, and by the use of a skin thick enough to prevent wrinkles.

The machine is expected to be flying early next year.

The Sabena Accident

THE cause of the accident to the Sabena Savoia-Marchetti, briefly reported in our issue last week, is now definitely stated to have been structural failure. Apparently wing (or aileron) flutter developed as a result, probably, of excess speed while flying blind. The findings of the official German-Belgian commission were published last Sunday—six days after the tragedy.

An Air France Transfer

THE London office of Air France has lost a popular member of its staff in six-foot-two André Evrard, who left London last Saturday to take over the company's offices at Hanoi. This is the second of Jack Bamford's French assistants to graduate to a Far Eastern station, the other being Charles Richet, who is now in control at Saigon.

Evrard is one of those Frenchmen who thoroughly understands the Englishman's particular sense of humour—perhaps because his early life was spent at Calais, where, during the war, when he was a lad of twelve, he made friends with the British troops. His earliest recollection is of himself, aged four years, reposing in a basket in front of his cousin's *bicyclette*, making daily excursions to the field from which Bleriot was planning to fly the Channel. He was there on July 25, 1909, and saw the take-off on that historic flight.

A Clacton Season

SINCE starting operations at Whitsun the Straight Corporation have carried 4,301 passengers on pleasure flights from Clacton, and some 600 on the daily ferry service which was operated between this point and Ipswich. The latter figure clearly indicates the demand which is still to be found for inexpensive day returns to seaside resorts, and the fact that the machines used both for service and for pleasure flying were based at Ipswich enabled a useful experiment to be made at a comparatively small cost.

The Straight Corporation, it will be remembered, also controls Western Airways, which operates a ferry service between Cardiff and Weston-super-Mare, and on this more than 24,000 passengers have been carried during the season. Obviously, the low fares charged on this and on the Clacton ferry have appealed to a section of the public which would not normally be expected to use air transport. At Clacton, Capt. J. R. King, who has had a long experience of joy-flying with various air display companies, has been in charge of the work.

SERVICE AVIATION

Royal Air Force and Official Announcements : *Fleet Air Arm News : Military Aviation Abroad*

ON THE NORTH-WEST FRONTIER : Once every two years the garrison of Chitral is relieved. Owing to the mountainous nature of the route, and the height of the pass (10,500ft.) it takes more than three days for the column to reach Chitral. This year, part of the forces concerned were flown up to a landing ground near Chitral, the journey taking less than one hour. Some of the relieving garrison — Sikh Sepoys—are seen entering a Vickers Valentia of the Bomber-Transport Flight at Risalpur.

The Mission to France

AIR CHIEF MARSHAL SIR CYRIL NEWALL and the members of the R.A.F. mission to France returned to this country last Saturday. During their stay in France they visited several air stations, notably Rheims, and were entertained by President Lebrun and by Gen. Vuillemin.

Arrangements were made for the party to see some of the new French military prototypes on the ground and in action and to witness the departure of bombers on a colonial cruise. Mock combats and mass parachute jumping were presented. The visitors also inspected aircraft and engine factories.

Blenheim Developments

BLENHEIM bombers have now made their appearance in a number of squadrons overseas. The first unit to be completely equipped outside Great Britain is No. 30 (B.) Squadron stationed at Habbaniya, Iraq, and commanded by Sqn. Ldr. G. H. Stainforth, A.F.C. Blenheims have covered the 811 miles between Habbaniyeh and Aboukir in 3¼ hours at an average speed of 250 m.p.h.

Some new performance figures for the Blenheim have lately been released by the Bristol company. Range and speed are both improved, as compared with the figures given last year, though the rate of climb is lower. The new data are: Speed at sea level, 240 m.p.h.; at 5,00ft., 254 m.p.h.; at 10,000ft., 269 m.p.h.; at 15,000ft., 285 m.p.h.; at 20,000ft., 277 m.p.h.; climb to 5,000ft., 3.7 min.; to 10,000ft., 7.2 min.; to 15,000ft., 11.5 min.; to 20,000ft., 17.5 min.; service ceiling (estimated), 27,280ft.; estimated range at nominal speed of 200 m.p.h., 1,125 miles; take-off run, 296yd.; landing run with brakes, 364yd.; landing speed, 50 m.p.h. indicated air speed.

THE ROYAL AIR FORCE MISSION to France visited the Hispano-Suiza factory at Bois Colombes, near Paris. Prince Poniatowsky, Government Administrator at the factory, is seen showing Air Chief Marshal Sir Cyril Newall what appears to be a Hispano 14AA fourteen-cylinder radial (approximately 1,100 h.p.)

Balloon Barrage Progress

WE understand that in the ten squadrons of the Balloon Barrage in the London district have all been provided with their establishment of forty-five balloons, winches and trailers apiece. The reason why only a comparatively small number of balloons was flown at the recent demonstration is the lack of trained personnel. Recruits are urgently needed for the squadrons.

The Air Ministry considers that the results of the small-scale exercise are "satisfactory and useful." An official statement says: "Only a small number of balloons were flown from their war sites, but the majority of these sites were chosen as being the most difficult from the operational point of view. The inflation and letting-up was carried out without a hitch under weather conditions which were by no means ideal. Although four of the balloons broke loose, the cause of these accidents was a technical one which is simple of rectification. The Air Officer Commanding has expressed himself well pleased with the promise shown by the volunteer organisation, but it is important that recruitment should be carried on until establishments have been filled."

The Aden Hinterland

NO. 8 (B.) Squadron seems to be continuously busy in keeping the peace in the Aden hinterland. This summer the squadron has had to deal with an unusually stubborn tribe, the Mansuris, who began to interfere with traffic on the Mafalis road last June. An ultimatum was sent to the tribe, and then the usual warnings were dropped. The Mansuris, of course, left their villages and took to caves in the hills, which are well concealed by scrub jungle. Rains had filled a number of ponds, so that keeping them away from the wells had no effect.

The tribe's country adjoins that of the Imam of the Yemen, which had to be respected, and consequently the aircraft found unusual difficulty in bringing the matter to a rapid conclusion. The operations began in July, and it was only in September that the Mansuris showed signs of weariness at their enforced residence in caves. However, such air action can be kept up indefinitely without casualties on either side, and the tribe must submit in the long run. It is hoped that the Mansuris will soon submit.

SERVICE AVIATION (CONTINUED)

Recruiting Return

THE total number of men enlisted during the past week is 716, making a total of 9,325 since the campaign began sixteen weeks ago. The object of the campaign is to obtain 31,000 pilots, observers, airmen and boys.

R.A.F. Benevolent Fund

THE attention of all Army officers seconded to the Royal Air Force is invited to the existence of the R.A.F. Benevolent Fund. Army officers holding temporary commissions in the Royal Air Force are eligible for help from the fund whilst so serving, and also subsequently if they are in distress for reasons which are definitely attributable to service with the Royal Air Force.

Fleet Air Arm

AN Admiralty order states that officers will be eligible to specialise as pilot or observer in the Fleet Air Arm immediately they have obtained their naval watchkeeping certificates, provided they are then under 24 years of age.

The next open competitive examination for the entry of air apprentices in the Royal Navy will be held in the third week of next March and the successful candidates will be entered in August.

The Air Arm in Waziristan

THE R.A.F. has often complained, unofficially, that it has not been given sufficient freedom to deal with risings on the N.W. Frontier of India. Last April, however, the Commander-in-Chief in India decided that the aeroplane was to be the main striking weapon in dealing with the Wazir tribes who had been stirred into unrest by the Fakir of Ipi.

During June the operations were carried out by detachments of Nos. 27 and 60 (B.) Squadrons from Miranshah, and in July flights of the same squadrons carried out fourteen raids on the village of Sharkai, where the Mullah Sher Ali had taken refuge. The usual warnings to evacuate were given, and the property of the recalcitrant villages was then attacked. The operations lasted for six weeks and involved over 2,500 hours of flying, with no forced landings. In all cases the rebellious tribesmen submitted sooner or later to the Government's terms.

The Fakir of Ipi was forced to move from the Kharre area to the mountainous country to the south of the Upper Tochi valley; while the Shamon Khel Mahsuds voluntarily paid Rs.15,000 as security, though no terms had been demanded.

Pyrotechnic Signals

THE attention of all concerned is drawn to the danger of starting fires by the firing of cartridges, signal, 1¼in., from aircraft in flight over the land, at heights which do not allow sufficient time for the composition of the stars to be completely burnt out. The average time of burning of the present cartridge, signal, 1¼in., is 8-10 seconds, but in the possible event of a defective star, it may burn for 15-20 seconds. To guard against the danger of causing ground fires, cartridges, signal, 1¼in., should be fired in an upward direction, but where it is possible only to fire the pistol pointing towards the ground, they should not be fired at a lesser height than 2,000 feet, unless weather conditions render this essential.

Troop-carrying

DURING the past summer some interesting experiments were made in transporting troops in a Valentia. During the season 5,270 men were taken into the air, mostly for flights of only fifteen minutes, and on those flights only six men were air-sick—a fact which probably proves very little in view of the brevity of the trips. On one occasion, however, two parties of the Coldsteam Guards were carried from Odiham to Catterick, each consisting of twenty men. In the first party ten men were sick, but in the second, which started immediately after the men had had lunch, none was sick. The air conditions were the same on both trips, so it seems that the accepted idea that it is unwise to start a long air journey on an empty stomach was borne out.

Flying Accidents

THE Air Ministry regrets to announce the following accidents:—A.P/O.s Thomas Campbell Dunn, John Astley Cooper, and Ronald Vincent Hart, lost their lives, and A.P/O. Robert Andrew Desmond Meharey was slightly injured, in a collision in the air which occurred at Penrhos, Caernarvonshire, on October 11, between two aircraft of the Advanced Training Squadron, No. 10 Flying Training School, Tern Hill, Shropshire. A.P/O.s Dunn and Meharey were the pilots of the two aircraft.

P/O. Leslie Morley Barlow (flying solo) is missing and believed to have lost his life as the result of an accident which occurred at Spithead on October 11 to an aircraft of No. 22 (Torpedo Bomber) Squadron, Thorney Island, Hants.

Lt. (F/O., R.A.F.) John Newton Snow, Royal Marines, lost his life in an accident which occurred off the Bass Rock, Firth of Forth, on October 12, to an aircraft of No. 801 (Fleet Fighter) Squadron, embarked in H.M.S. *Furious*. Lt. Snow was the pilot and sole occupant.

Royal Air Force Gazette

General Duties Branch

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—A. D. Murray, R. J. B. Burns (September 16); B. A. C. Wood (September); G. A. Richmond (October 3).

Sqn. Ldr. E. A. Beaulah is granted the acting rank of Wing Commander (unpaid) (August 3); Sqn. Ldr. J. C. E. A. Johnson is granted the acting rank of Wing Commander (unpaid) (October 22) on appointment as Air Attaché, Helsingfors; Flt. Lt. R. J. Montgomery-Moore (R.A.F., Ret.) is granted the honorary rank of Squadron Leader (September 28); F/O. B. B. St. G. Daly (Captain, The Lancashire Fusiliers) is granted the honorary rank of Flight Lieutenant (August 29); Flt. Lt. F. A. A. H. Strath is transferred to the Equipment Branch on probation (September 27).

Dental Branch

F/O. G. W. Hargreaves, L.D.S., is promoted to the rank of Flight Lieutenant (September 6).

Royal Air Force Reserve

Chaplains Branch

No. 500 (COUNTY OF KENT) (BOMBER) SQUADRON.—The Rev. H. R. Carmichael is appointed Chaplain with the relative rank of Squadron Leader (August 6).

General List

J. M. Wells is appointed to the General List in the rank of Flight Lieutenant on relinquishing his commission in the Auxiliary Air Force (August 16).

Owing to the greatly increased length of these lists, as a result of R.A.F. expansion, ranks are confined to those of Flight Lieutenant and above.

SPITFIRES ON SHOW: At the recent opening of the new Cambridge Aerodrome by Sir Kingsley Wood, the new Supermarine fighters made their first public appearance as R.A.F. equipment. Ejector-type exhausts have now enhanced the already impressive performance of these machines.

SERVICE AVIATION (CONT.)

FOREIGN SERVICE NEWS

Hampden for Sweden

A HANDLEY-PAGE Hampden high-performance bomber (two Bristol Pegasus) was ferried from England to Sweden recently by a Swedish crew of three—Wing Cdr. Enderlein, Capt. Westering and Engr. Lt. Benstson. It is possible that considerable numbers of these machines will be built in Sweden.

The machine took off from Heston and reached its destination, 1,100 miles away, non-stop in five hours.

Pratt and Whitneys for France

AS already announced in *Flight*, the French Government has bought the licence to manufacture two-row Pratt and Whitney radials, chiefly, if not entirely, of the Twin Wasp type. According to a message from New York, Mr. Donald Brown, president of United Aircraft (which embraces Pratt and Whitney), has declined to confirm or deny a report that France has ordered six hundred engines direct from America, declaring that an announcement on such a subject must come from the French Government.

It is believed that the first installation of a Pratt and Whitney engine in a French military prototype concerns the Bloch 151 single-seater fighter which has two shell-guns in its wing and was originally fitted with a two-row Gnome Rhone radial.

Prototypes in France

THE Koolhoven FK-58 monoplane fighter, described in *Flight* of October 6, recently reached a speed of 500 m.p.h. during diving tests at Villacoublay.

Other prototypes on test include the Galtier 30 single-seater fighter built of wood and fitted with an Hispano-Suiza Series X engine incorporating a shell gun. The Romano 110 three-seater fighter with two 450-h.p. Renault inverted-vee engines is also on trial.

The latest product of the S.N.C.A. du Midi is the Dewoitine 520 single-seater fighter with Hispano Series y *moteur canon*. This model does over 300 m.p.h. and its structure has been designed with a view to very rapid production, utilising hydraulic presses. It has been stressed to take engines of as much as 1,100 h.p. Incidentally it is the thirty-fifth prototype tested by Marcel Doret.

Col. Lindbergh has been permitted to fly a Morane 406 single-seater fighter. The thirteenth machine of this type has left the production line at Puteaux.

Reorganisation of the French Air Force

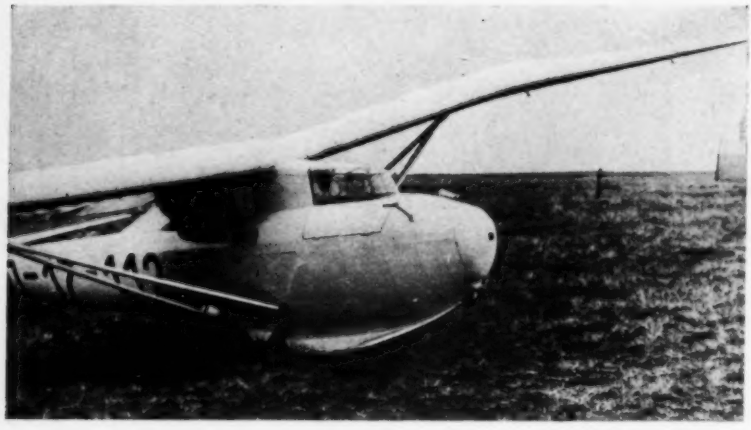
THE present organisation of the French Air Force, brought into being in 1936, provides for the separation of the operational from the administrative commands. All combatant aircraft are grouped into two air corps, one fighter and the other bomber. The general officers commanding these two corps and their subordinates are responsible only for the operational training of their units. All administrative matters, including supply, repair, rationing, pay, etc., are placed under the command of general officers commanding the four Air Regions into which the Metropolitan territory is divided, a fifth Region grouping the Air Force in North Africa.

This organisation, which is due to M. Pierre Cot and his *Chef de Cabinet* General Jauneaud, has now been in operation for nearly two years. The new regime at the Air Ministry, under M. Guy la Chambre, has come to the conclusion that it cannot work satisfactorily. It has been found that, in practice, much delay has been caused by the fact that, for instance, the officer commanding the operational units on a particular aerodrome has no control over the repair and supply units on the same aerodrome. If he wished a repair to be carried out, it was necessary to apply to his Corps Commander who then got in touch with the Regional Commander, who instructed the Base Commander on the aerodrome concerned to carry out the repair required by the *Escadre* Commander, whose office was situated probably not more than fifty yards from his own.

It has therefore been decided to revert to the organisation which was in operation prior to October, 1936. The Corps are to be suppressed and the whole command, both territorial and operational, in a given area will be vested in the Regional Commander. Equally, the operational units on a given aerodrome will be grouped into brigades or demi-brigades, as the case may be, and the senior officer on any given aerodrome will be in command of all establishments of any kind on his aerodrome.

The various formations in the Air Force will therefore in future be known as regions, sub-divisions, brigades, demi-brigades and *escadres*.

TURKISH BLENHEIMS: In the first of the top views Flt. Lt. C. A. Washer, a Bristol test pilot, is seen with officers of one of the Turkish Blenheim squadrons. The main group is of officers and N.C.O.'s of Nos. 24 and 25 squadrons. In the centre of the back row with his hand in his tunic is Lt. Col. Sevket Acar, commanding Gazi Emir aerodrome, Izmir. Third from the left in the back row is Capt. Kula, commanding No. 25 squadron, and fourth from the right is Capt. Farhi, commanding No. 24 squadron. The third view shows a line-up of the Blenheims.



MOTORLESS ENDURANCE : Tandem-seated in the well-protected if not too roomy cockpits of this sailplane, two Austrian pilots, Toni Kahlbacher (left) and Josef Führinger, remained aloft for 40hr. 51min. on September 8-10 after an aero-tow to 1,500ft., thereby setting up a new world record for two-seater gliders. According to *Flugsport*, they subsisted on an uninspiring diet of biscuits and water.

THE AERONAUTICAL BOOKSHELF

Stage and Sky

"Robert Loraine," by Winifred Loraine; 10s. 6d., Collins, 48, Pall Mall, London, S.W.1.

MRS. LORAINE has written an extraordinarily fascinating history and character study of her late husband—an unusual man, not to be summarised in a few words. He will be remembered as a great actor, but to *Flight* he remains one of the pioneers of flying and an officer of the R.F.C. who won the D.S.O. and the M.C. in the Great War. Incidentally, he also fought as a trooper of the Imperial Yeomanry in the South African war; so his bar of medals was impressive. In the air he was twice wounded, once in the lung and once in the knee, and he suffered from the effects of both to the end of his life.

The accounts of his early flying and his crossing of the Irish Sea in a primitive Farman are very good. The details are correct yet not too technical for the lay reader, and these chapters of the book are a valuable addition to the history of air pioneering No less admirable is the story of his service in the R.F.C., where he was a ham-handed pilot who maltreated his engine, but was always as brave as a lion. His deserved unpopularity as the commandant of a training station is not glossed over.

Robert Loraine the man makes one rather impatient, but he did much good work in all his rôles, and he has found an understanding and very competent biographer.

The Gunner's Angle

"Hell in the Heavens," by A. G. H. Whitehouse; 6s., W.R. Chambers, Ltd., 38, Soho Square, London, W.1.

MR. WHITEHOUSE seems to have had more war adventures than most people, and it is a pity he did not choose to set down his reminiscences before the mists of time tended to veil them in his retrospective mind. Nevertheless, he has strung together a fine collection of yarns woven round his experiences as an air gunner in the Royal Flying Corps. Many a dubious eyebrow will be raised over some of the pages, but if (as sometimes seems to be the case) the author has failed to keep strictly to the paths of truth, he has at least given a vivid idea of the arduous and perilous duties of those he is so fond of terming the P.B.O.s—an abbreviation for poor qualified observers.

Apart from his reminiscences he throws in some acceptable scraps of information and chronicles events with which he himself was not associated. For example, he describes the destruction of a balloon-strafing Fokker by Lt. Neibling, an American observer attached to the French 73rd Balloon Company, whose chosen weapon was a Colt automatic pistol. The last two of his five shots were fired after he had vacated the basket of his burning balloon over Maize.

Then he mentions Bob Scanlon, the first—and probably the only—negro airman, who was gunner for Norman Prince in an old Voisin which was armed with a shell-gun.

The majority of Mr. Whitehouse's flying was in F.E.s and Bristol Fighters with No. 22 Squadron, which was at one time unwittingly pitting itself against the Richthofen Circus. It seems that the Brisfit, due to the proximity of the observer to the pilot and to the general handiness of the type, was at first mistaken by the enemy for a single-seater, much to their sorrow.

Above all, Mr. Whitehouse is frank in the unembellished American style of to-day.

Shapes and Sizes

"Aircraft of the World Recognition Book." Compiled by Eric Sargent; edited by Paymstr. Lt. Cdr. E. C. Talbot-Booth, R.N.R.; 7s. 6d., Sampson Low.

"ALL recognition books," bluntly remarks the editorial foreword to this impressively fat little volume, "are fatuous." Be that as it may; if they are to be published at all they should be compiled with meticulous accuracy, otherwise they are very much worse than fatuous. And that is where, in some degree, this work falls short. The general arrangement silhouettes are rather crudely drawn, particularly those set out from photographs. The Hurricane, Spitfire and Wellesley, for example, are barely recognisable.

Though they set out to be helpful, the brief annotations are also frequently inaccurate and slap-dash. In fact, the presentation of whole mass of material conveys the idea that after the initial burst of enthusiasm the responsible parties began to be appalled by the magnitude of their task.

Nevertheless, at 7s. 6d. the book is quite worth buying, if only to illustrate the enormous variety of aircraft shapes and sizes. There are, incidentally, some useful lists of manufacturers and charts of international markings.

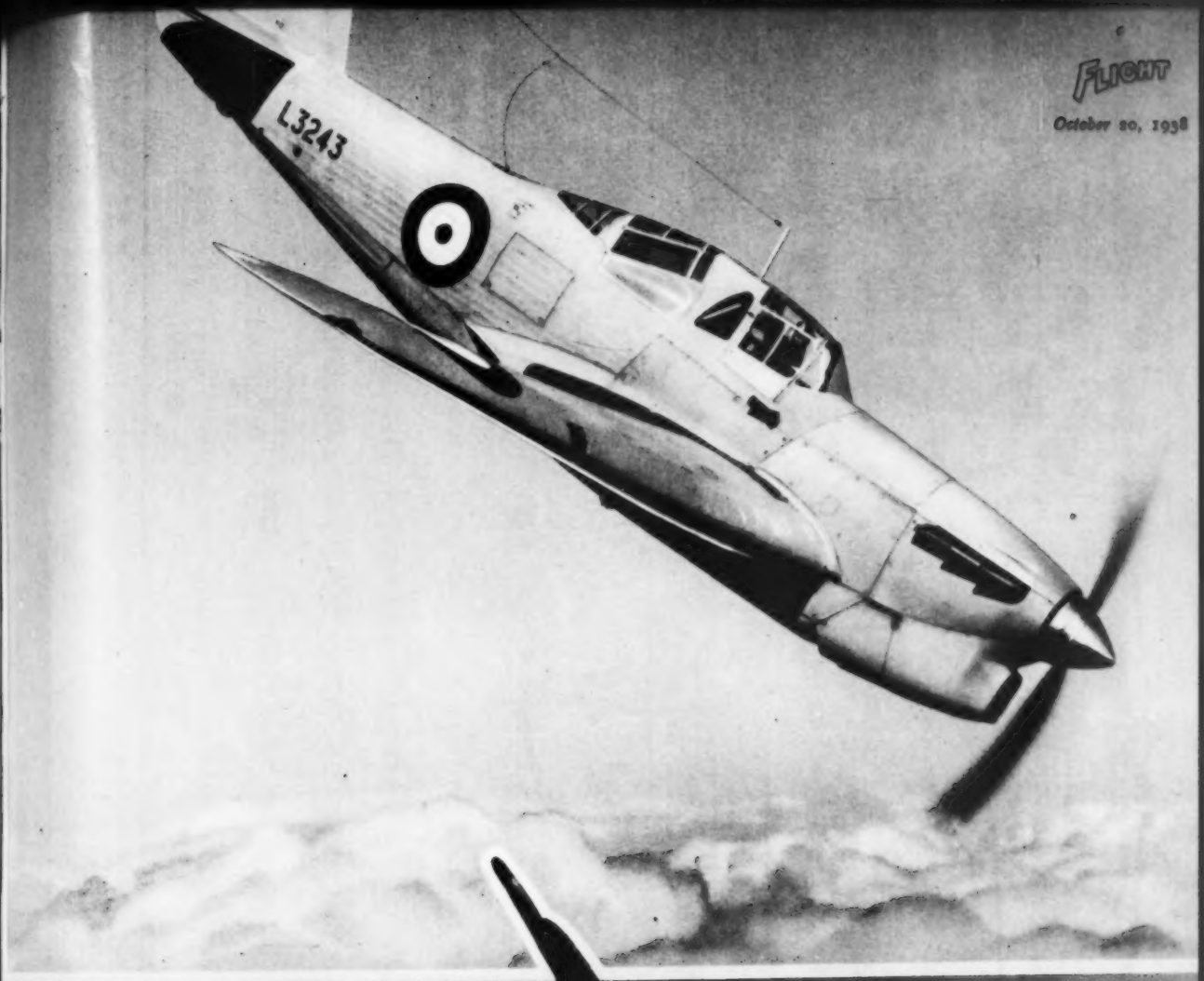
Elementary Atmospherics

"The Air and Its Mysteries," by C. M. Botley; 8s. 6d., G. Bell and Sons, Ltd., Portugal Street, London, W.C.2.

DESIGNED for popular consumption, this book might nevertheless be useful to newcomers who find that the textbooks of meteorology are a little too advanced for immediate understanding. Furthermore, it has the special advantage of being eminently readable and filled with little historical and other items which provide a background for more erudite studies.

Miss Botley, after dealing with the more straightforward aspects of her subject, has devoted the penultimate chapter to the direct effects of wind-flow and so forth on the flight of both birds and aircraft. Her explanation of the R101 disaster, for instance, is interesting and, apparently, authentic. The final chapter deals with the upper layers of the earth's atmosphere and the possibilities of the future. Remembering our early scientific training, it is interesting to learn that the upper atmosphere, as measured by the presence of the aurora, reaches a height of more than 600 miles.

[*Concluded after photogravure section.*



TUG O' WAR

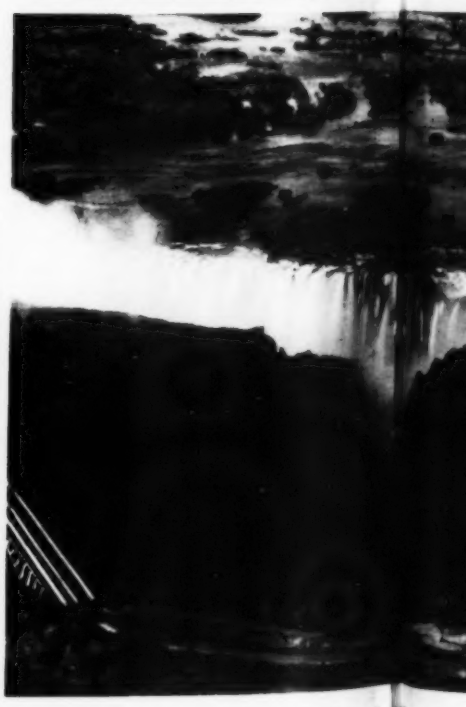
High-speed towing of drogue targets is the chief duty of the new Hawker Henley (Rolls-Royce Merlin) shown in these special *Flight* photographs. The drogue cable is wound on a winch driven by a windmill, which can be seen in its out-of-action position, turned edge-on to the slipstream.

AFRICAN TOUR

Some out-of-the-ordinary Photographs by Willi Ruge, a German Pilot who Recently Made a Trip to the Cape in a Bücker Monoplane.

A desert Arab's tent, with walls rolled up.

(*Below*) Feluccas on the Nile.



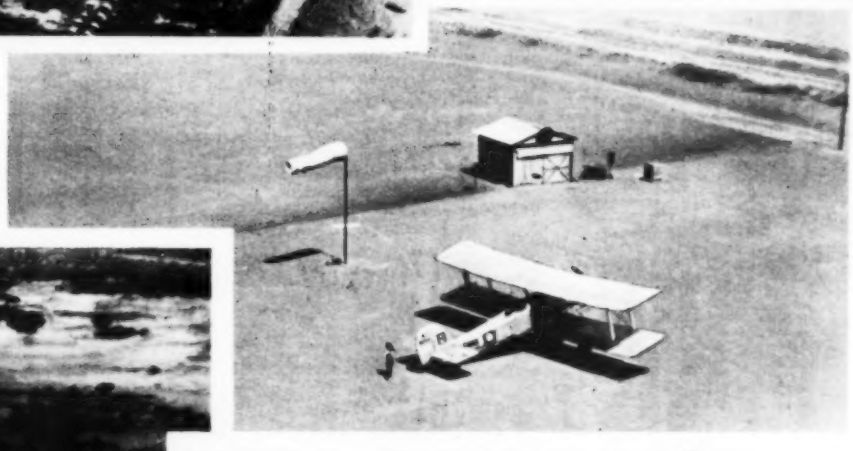
Where the waters of the Zambesi, a mile [illegible] roar into

The world-famous Luxor excavations.

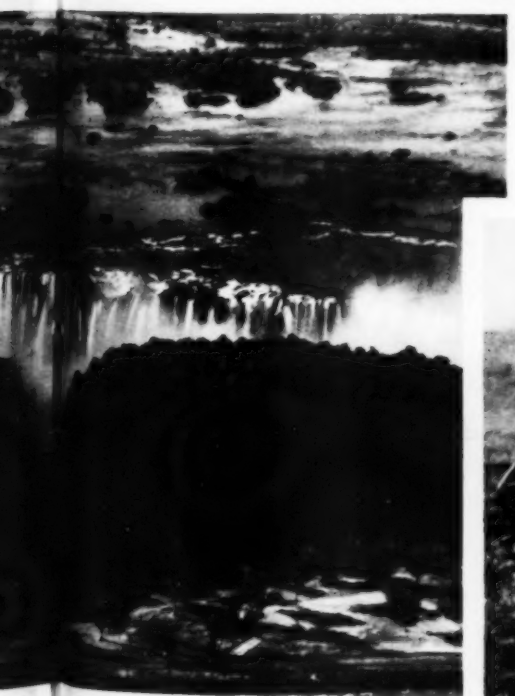
(*Above*) Refuelling the Bücker in the rain.

(*Right*) An R.A.F. Vickers Vincent at a desert landing-ground.

(*Left*) Keeping him cool—seen near Livingstone.

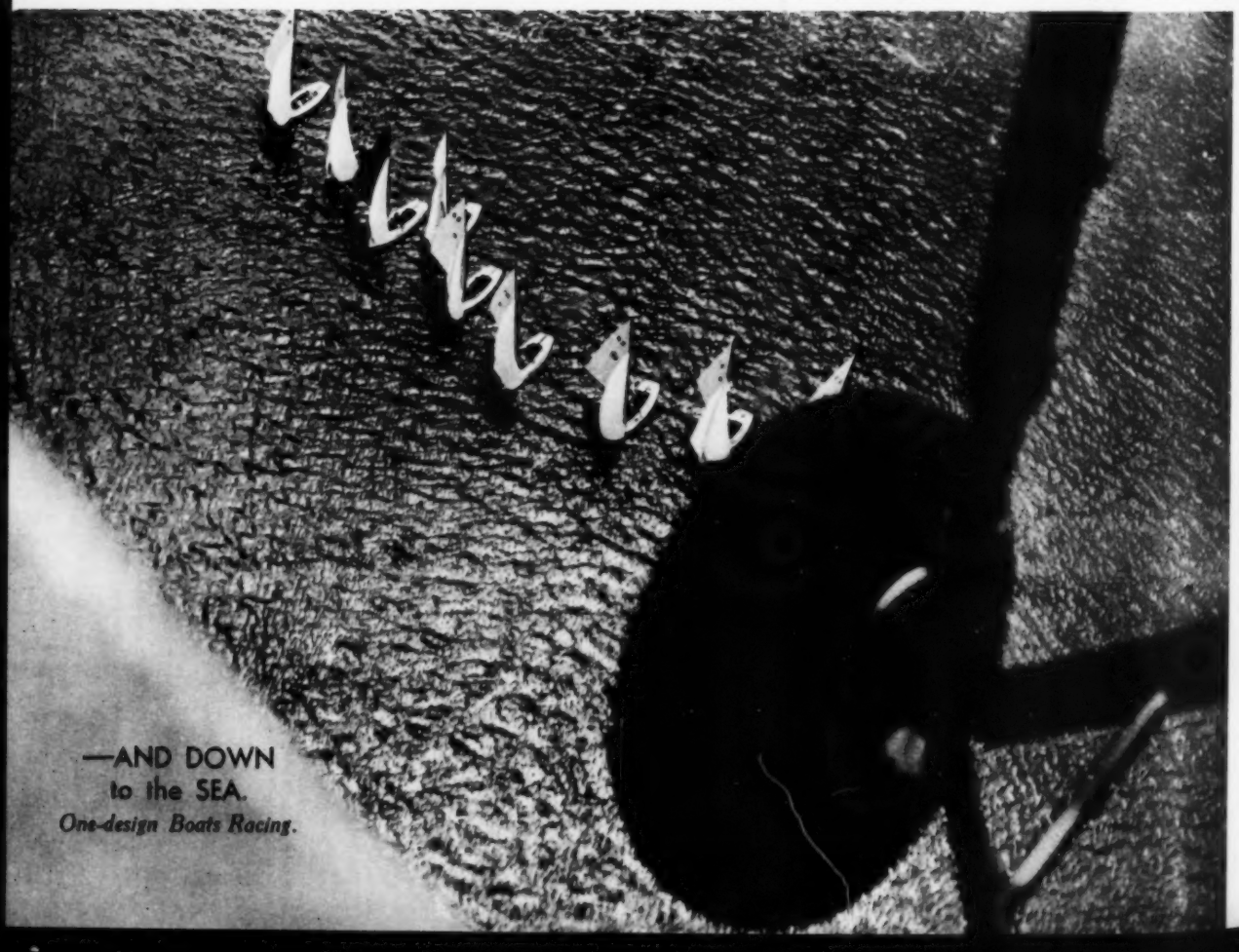


(*Below*) A clean bill of health: signing medical certificates in a yellow-fever area.



, a mile [illegible] rear into a 350ft. gorge—the Victoria Falls.

THROUGH the WINDOW—
A Boeing B-17 Bomber.



—AND DOWN
to the SEA.
One-design Boats Racing.

THE AERONAUTICAL BOOKSHELF (CONTINUED)

Birds—

"The Flight of Birds," by C. Horton-Smith, B.Sc., D.I.C.; 7s. 6d., H. F. and G. Witherby, Ltd., 326, High Holborn, London, W.C.1.

ALTHOUGH throughout the centuries the flight of birds has caused man to ponder, if only with envious mind, he must confess that until quite recently he has known extraordinarily little about the subject.

As Sir Gilbert Walker, F.R.S., indicates in his foreword to this little book, the difficulties of research into bird-flight demand an unusually wide range of qualifications, including a technical knowledge of zoology and aerodynamics.

Just how complex a subject is the study of bird-flight soon becomes obvious from the book. After the first chapter, which deals with man's early efforts in the study of flight, Mr. Horton-Smith takes the reader back to a very dim past, to the time when a bi-pedal reptile ran in a series of leaps, using its under-developed fore-limbs for balancing purposes and to "grasp" the air. In simple stages he traces the development of birds throughout the ages, explaining with the aid of drawings and diagrams the outstanding anatomical features which have become so well adapted to flight. A chapter deals in some detail with wing construction and distinctions due to specialisation brought about by the food question. As the reader soon realises, this chapter is important, for it enables him to understand fully why the wings of certain birds have developed along particular lines.

From this detailed study of avian form the reader is taken into the realms of flight. The author's own views do not allow him to omit quoting those of other authorities.

Aero engine designers will no doubt find comfort in the statement that "A bird expends far more energy in rising than in normal horizontal flight. Repeated 'take-offs' from the ground leave many birds utterly exhausted."

—and Early Birds

"Early Birds," by Alfred Instone; 6s. Simpkin Marshall.

AFTER nearly two decades air transport has almost reached the stage when it may be considered seriously to have a publishable history. At present, perhaps, a story of the very early days is still of interest largely to those who were connected with civil aviation between 1919 and 1934, when the original companies were merged into Imperial Airways.

Early Birds is the story, not too well written and in great measure dependent on quotations from newspaper reports, of the work of the Instone Air Line prior to its incorporation. Very little is said about the work of other companies which were in operation at that time, but it is good that the history, however documentary and staccato, of one of the pioneers should so be put on record. Although the book is not likely to appeal to the casual reader, it should certainly be of great interest to those who were either with Instone Air Lines or with the other companies at Hounslow and Waddon.

"The Next Air War"

"Air Power in the Next War," by J. M. Spaight, C.B., C.B.E.; 5s.; Geoffrey Bles, 2, Manchester Square, London, W.1.

OUR minds are still full of the recent crisis, of gas masks, trenches, evacuation, and all the rest of it. Chance conversations with all sorts of people during that period made it apparent how little is known about air power, even by those who *should* know. Before the memory of that crisis fades, everybody, we unhesitatingly affirm, ought to read Mr. Spaight's *Air Power in the Next War*. It is short (175 pages), it is easy reading, it is more than knowledgeable, it examines all doctrines and theories of air power, it dispassionately sums up possibilities and probabilities, and it draws conclusions which will convince all but the fanatics.

Space is lacking for even a summary of all Mr. Spaight's arguments and conclusions, but a few may be mentioned. There is no fear, he tells us, of any country being drenched with bombs, and outside large centres A.R.P. can be overdone. "If we have left undone things which we ought to have done in the Whitechapel Road, it will be poor consolation to feel that we have done things which need not have been done—which might have been left to Providence—in the diocese of Exeter."

Even all military objectives cannot be bombed, for there will not be enough aircraft. When armies are fighting they will monopolise most of the air effort. A monthly production of 600 or 700 aeroplanes is modest compared with 1918. Then we had a first-line strength of 3,300 machines, and to maintain 100 squadrons of 18 machines at the front (1,800 aeroplanes) we had to produce 1,000 machines a month *plus* others for home defence. Yet in 1918 neither we nor the Germans could spare many squadrons for bombing behind the lines. Still, the bunching of shadow factories in Coventry and Birmingham Mr. Spaight calls an "amazing decision."

As for the chances of air defence, he examines all available evidence from the recent and present wars, and concludes, "It is by no means a foregone conclusion . . . that 'the bomber will always get through.'" In Spain the fighter has had the upper hand, and, as French observers remarked, "Speed alone gives some security to the bomber." But some bombers will get through. What will they do? Mr. Spaight doubts whether indiscriminate bombing of cities is so certain as some prophets think. More probably they will attack military targets in the cities, and the bombs which miss the targets will kill civilians. He doubts whether gas bombs will be dropped; they have not been used in Spain.

If cities are heavily bombed, will that break a nation's will to resist? Mr. Spaight cautiously uses the expression "it is doubtful" if it will, but evidently he has no doubts at all himself. He quotes Marshal Foch in 1926 when he said, "You cannot scare great nations into submission by destroying their capital cities."

If, however, air bombardment is directed against factories, then "air power may in fact prove itself capable of effectively disarming even a powerful nation, but only if it sets itself to that task, which is a different task from trying to bomb civilian populations into defeatism." But clearly "no nation believes that victory can be achieved by air raids alone."

A belligerent country not governed by common sense may, Mr. Spaight admits, use its aircraft wildly and brutally. For "a country like our own" he lays down a doctrine of air power in eight articles, which are well worth quoting:—

(1) The destruction of the enemy's military strength will be the end sought by air power.

(2) The air arm will be used wherever and in the manner in which its use is best calculated to serve that end.

(3) Attack on the enemy's sources of munitionment and his lines of communication and supply, as well as on his armed forces, will be an important contributory means to that end.

(4) It is possible, though this is not certain, that military objectives in densely populated centres will not be attacked if they are so situated that bombing would be tantamount in its results to indiscriminate bombardment. (Such seems to be the implication of our protest in regard to the bombardment of Barcelona in March, 1938, but the terms were not entirely clear.)

(5) We will not initiate the use of gas.

(6) Merchant vessels will not be sunk or disabled in any circumstances other than those in which they could lawfully be sunk or disabled by warships, surface or submarine, nor will they be diverted without prior boarding at the place of encounter.

(7) If the enemy on his side uses air power in a different and more ruthless fashion there will be an immediate and effective *riposte* on our side.

(8) We shall be prepared for the worst while hoping for the best.

In Defence of the Airship

"What About the Airship?" By Commander C. E. Rosendahl, U.S. Navy; 10s. 6d., Charles Scribner's Sons, Ltd., 23, Bedford Square, London, W.C.1.

COMMANDER ROSENDAHL has had great experience in both German and American airships, and he is naturally disappointed that rigid airship activity in the United States has come to an end for the time being. In this book he urges that it ought to be resumed, especially in view of the fact that his country has a practical monopoly of helium. He argues that the helium airship can be made useful for both commercial and naval purposes.

His claims for the naval airship would certainly be hard to controvert. Carrying aeroplanes, and equipped with an observation car which could be lowered from an airship hidden in the clouds, it ought to be a most useful naval scout. As for the commercial airship, there would probably always be a certain number, quite possibly a large number, of passengers who would prefer travel in such an aircraft to the greater luxury of the steamship and the greater speed of the aeroplane (including the flying boat) for crossing the ocean. What this author does not set forth convincingly is the chance of a helium airship paying its way without a large subsidy.

This book with its 431 pages is too long, and there is much repetition of statements and arguments. Moreover, the gallant author is no logician, and in more than one instance supports a good case with arguments which are not really convincing.

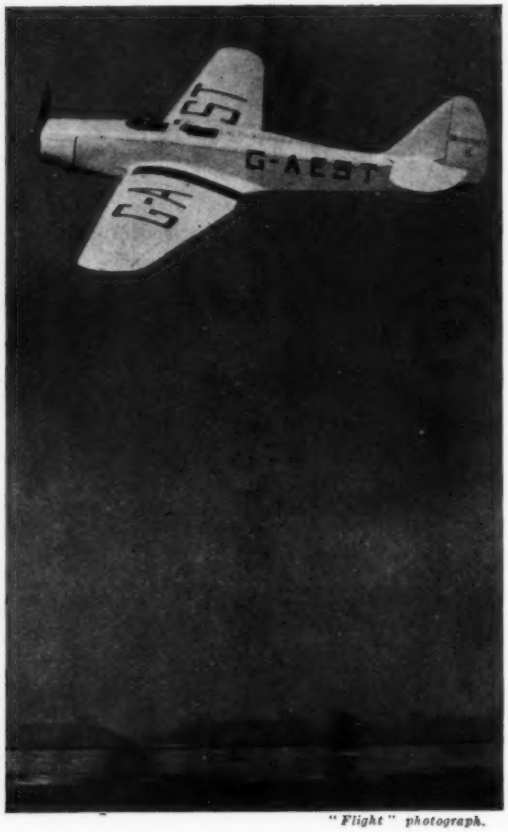
PRIVATE FLYING

The Reaping

ALTHOUGH the number of C.A.G. applications received so far has hardly reached the astronomical figures which were originally suggested by some people, the total has probably exceeded the estimates of those who were in the best possible position to know how much incipient enthusiasm there was. The fact seems to be that this scheme has given the clubs and schools just that extra publicity which was necessary to produce results.

A vast number—probably the greater proportion—of the applicants have been those who could very well have afforded and found the time to fly at the old rates. The majority of them, however, had not even considered the idea until it was, so to speak, pushed under their very noses—with the special attraction of cheapness. Nobody ever doubted that there are a tremendous number of people who are keen on flying; it would be a poor state of affairs if, after thirty years of aircraft development and the interim arrival of a couple of new generations, this was not so.

Perhaps, in the course of all the arguments for and against the scheme, one very important aspect has been overlooked. Let us admit that a ten-hour soloist is very little use to anyone as a pilot; that 70 per cent. of the new pupils could quite easily have flown under the old arrangements; and that the entire scheme is being run somewhat at the expense (moral, if not financial) of the original enthusiasts. Forgetting all the claptrap about obtaining a reserve of pilots, doing one's bit, getting people into the air, and so forth, the new subsidy scheme is, in effect, a subsidy for aviation in its entirety.



"Flight" photograph.

DEVELOPMENT TYPE: The "sports model" Mosscraft flying at Hanworth. A trainer version, with a Cirrus Minor engine, is in course of construction.

Cheap Boost

IF, at the comparatively small cost of a higher club subsidy (which is all the C.A.G. scheme amounts to), the general public has been fed on the idea of cheap flying during the last few months, and if 30,000 pupils can be got into the air in the next two years, then the entire flying business must have received a boost which is out of all proportion to the expenditure.

Practically every one of the new pupils will be—to use an abominable expression—air-minded, and will be ready to use air services when and if these are operated to a satisfactory time-table. At present two-thirds of these services are virtually useless to man or goods in a country where ground transport has reached such a high state of development. During the summer holiday periods dozens of prospective passengers, with money in their hands, were turned away at a large airport in the North Midlands. The operating company simply could not provide the necessary seating capacity, and until they feel that such a demand will be made more or less consistently throughout the summer one can hardly blame them for not providing, at considerable cost, this necessary capacity.

At the end of two years an important section of the community will have obtained the right ideas about flying. That, in itself, is worth far more than any subsidy which could possibly be paid directly to the transport operating companies, or even to the manufacturers. At long last, too, the British Government appears to be taking civil aviation seriously—to the tune of ordering really large and advanced transport aeroplanes—and this C.A.G. scheme, with all its demerits, is just one sign of the fact that the need for active encouragement has been realised.

Landing Fees

THOSE airport owners and others who have studied the list of landing and housing charges for various types of aeroplanes, recently issued by the Aerodrome Owners' Association, cannot possibly complain about their magnitude—except, perhaps, where really large aeroplanes are concerned. The majority of light aeroplanes may be landed anywhere at a cost of 1s. 6d., and lighter types at the trivial and nominal cost of 1s.

That seems to be fair enough. Somebody has got to pay for the initial and upkeep costs of aerodromes, and these shillings may help to pay a part of the groundsmen's salaries—though they are not likely, when viewed on a balance sheet, to impress the less progressive ratepayers.

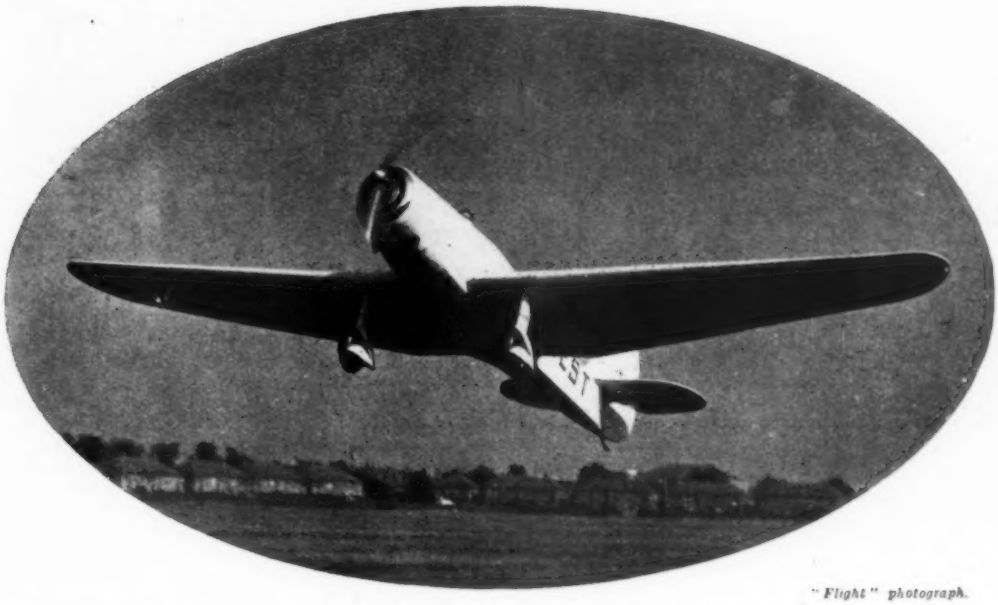
But surely some arrangement should have been made about the business of practice landings. For any club which is permanently attached to an aerodrome special arrangements are usually made, but there are many occasions when a prospective purchaser, or other interested person, wishes to try a new type and to make, in the course of this trial, a vast number of approaches and landings in order to discover all about the only features of a machine which really matter.

When the number of these landings runs into dozens such a try-out can become rather expensive, and nobody is going to tell me that each one of these does even a shillingsworth of damage to the aerodrome surface. No doubt the Aerodrome Owners' Association thought about this point but did not consider that it was worth special legislation. In the meantime, those unfortunates who have been carrying out a number of successive landings must pay out 15s. or 20s. with as good a grace as possible. There is the club-C.A.G. landing charge question, voiced by the Cardiff Club in last week's issue. They await opinion.

I do feel, however, that something ought to be done about practice-landing charges. As it is, one tends to choose an aerodrome where no charges are levied at all, and that is hardly fair to the owner of such an aerodrome.

INDICATOR.

MODERN CONVENTION



"*Flight*" photograph.

Present Light Aircraft Tendencies and the Moss Prototype Discussed : Trainer Development : A Worthy Compromise

by H. A. TAYLOR

NECESSITY seems, in the aircraft world, to have been the mother of the cantilever monoplane. In spite of the attractive features of what was once known as the conventional aeroplane layout, efficiency has demanded the development of the monoplane type and, in particular, of the low- or mid-wing design. And the trainers, slowly but inevitably, have had to follow suit.

Not that with a good design the monoplane cannot be a better all-round machine from every point of view than the biplane; it is merely that constructors have had a little more experience of the latter. It is possible for a good low-wing monoplane to have certain safe and easy characteristics which cannot be obtained in a biplane. A safe, straightforward stall, an exceptionally easy landing and an excellent range of view for the pilot are essentially the features of to-day's type.

Exactly how the accommodation should be laid out is still a matter for argument. The side-by-side seating arrangement has quite pronounced advantages, but a fair proportion of experienced instructors still believe that a pupil may be more satisfactorily taught when he is, so to speak, alone with a set of duplicated controls. Furthermore, the tandem seating arrangement can provide one of the occupants, at least, with a field of view which can rarely be obtained in a side-by-side seater. This field, however, is only available to its fullest extent for the occupant of the front seat, and one important manufacturer has laid out his latest private-cum-trainer type with the pilot in front and overlooking the leading edge.

Provided that a suitable wing section is chosen, such an arrangement provides few difficulties with a fairly lightly loaded machine, and it is curious that, until comparatively

"*Flight*" photograph.

The vast extent of the split flap area in the Mosscraft is shown in this photograph, taken when the machine was on the point of touching down. Mr. W. H. Moss was flying when this and the photograph above were taken.

Private Flying

recently, no designer seems to have thought seriously of providing this type of layout. It says a good deal for the essentially common-sense features of the front-drive tandem-seater low-wing arrangement that another firm as long ago as 1936 decided that this was the best compromise in the development of an ideal private-owner type. Early in 1937 the five brothers Moss, all pilots, produced their own idea of what an economical private type should be. The machine was described in *Flight* of May 17 of that year, and only misfortune (and an hour or two) prevented Mr. W. H. Moss from flying in the 1937 King's Cup and, with an open two-seater machine, in the same race this year. Meanwhile, the Mosscraft, in its two forms, has, however, been seen about quite a lot.

THE MOSSCRAFT MONOPLANE.

Pobjoy Niagara III(95 h.p.) in Sports and Cabin versions; Cirrus Minor (90 h.p.) in Trainer.

	Cabin Type.	Trainer Type.
Span	34ft.	34ft.
Length	23ft. 3in.	23ft. 3in.
Weight empty	880 lb.	880 lb.
All-up weight	1,400 lb.	1,400 lb.
Wing loading	9.10 lb./sq. ft.	9.10 lb./sq. ft.
Max. speed	130 m.p.h.	127 m.p.h.
Cruising speed	120 m.p.h.	110 m.p.h.
Stalling speed (flaps down)	37 m.p.h.	37 m.p.h.
Initial rate of climb	700 ft./min.	640 ft./min.
Service ceiling	13,000ft.	13,000ft.
Cruising range	500 miles	550 miles
Price	£750	£695

Makers: Moss Brothers Aircraft, Ltd., Chorley, Lancs.

Certainly the business of flying from the front seat in any aeroplane, even a well-strutted biplane, gives one a remarkable feeling of being in full control of any situation. In a low-wing monoplane the whole world, except that immediately below the fuselage, seems to be in full and continuous view. This, of course, is an illusion, and only goes to suggest how bad the view must be in the majority of machines.

The major difficulty seems to be to provide the same degree of visual and physical comfort for the occupant of the rear seat. In the Moss, with quite an insignificant screen, it is comfortably possible to fly without helmet or goggles in front, but at the rear there is a chilling draught which arrives from behind—evidently the result of some complicated turbulence aft of the front screen. None of this mattered in the case of the original Mosscraft, which had a cabin top, but the sports model can also be considered as the test type for a trainer which is now in course of construction. Various experiments will be carried out until almost equal comfort can be given to both the occupants of this new machine, which should be flying early next year.

Otherwise—and except for minor fuselage differences, as a result of experience—the characteristics of the sports type, which I recently had a chance of flying, may be considered to be those which will appear later in the trainer. These characteristics are markedly pleasant from all points of view, and show that real stability and safety can be combined with adequate manœuvrability. The wing section is a modified R.A.F. 34, with a more or less stationary centre of pressure, so that there is little change of trim when the machine is flown solo or two up. In the prototype no trimming gear has been considered necessary, and this, in the form of a spring-loading device, will only be useful to provide really accurate hands-off trim on long journeys. As it is, with a passenger, the machine has a very slight tendency to climb when left to its own devices. There is absolute stability in all axes, and, in common with some other modern aeroplanes, it can be flown accurately on the stick alone—up to the point of really steep turns.

Safe Stall

Although the Mosscraft has been stressed for aerobatics (it now has a C. of A. in the normal category), it has not yet been put through spinning tests. This will be done, with a tail parachute, in a few weeks, but apparently Mr. W. H. Moss has been unable, using normally exaggerated control movements, to produce a spin. With the depth of fuselage and amount of rudder below the tail plane there is no reason to suppose that, if started, the spin will not be immediately corrected. I was satisfied to try the stall in various flap positions, with the rudder held more or less central. Even at an indicated speed of about 40 m.p.h. (or 37 with flaps down) the machine remains perfectly level, and there is still some aileron control. Only when the stick is brought right back and held there does the true stall develop. This results in a sudden but not particularly pronounced change in the fore and aft attitude, and one wing drops. The fact that the Mosscraft is regularly flown out of and into a microscopic and far-from-level field next door to the factory, which is part of the Moss varnish works, proves that there is nothing wrong either with the take-off or with the approach characteristics.

Accurate spot-landings are made easy by the fact that the mechanically operated flaps have a wide variety of positions. One can make the initial part of the approach on half the movement, retaining some, or all, of the rest of this movement to get rid of the final hundred feet or so. With the flaps in the fully down position the approach is extraordinarily steep, and it might be advisable for instructors to discourage their full use until the more advanced solo stages. Except at the Reserve schools very little experience has been obtained in *ab initio* instruction with flapped aeroplanes. There is ample time, however, to make a perfectly normal landing from an approach speed of, say, 55 or 60 m.p.h. with the flaps fully down, but the change of attitude from the glide to three-point landing is sufficiently pronounced to demand a fair degree of accuracy in height judgment. Up to an angle of 60 degrees the effect of the flaps is sober and helpful, and, when using the different positions to stretch or shorten the glide only the first 20 degrees or so changes the lift characteristics sufficiently to cause a slight loss, or apparent loss, of height.

Sideslipping

A good feature of the Mosscraft is that, contrary to experience with most machines of similar type, it can be sideslipped properly. If too much bank is not attempted a slip can be held accurately at an air speed of 60 m.p.h., and the control positions are more or less immutable. Experiments at a safe height with the flaps up or down showed that there was no likelihood of tail control wash-out in normal attitudes and at reasonable speeds. The Mosscraft, in fact, behaves like any good trainer in this manœuvre. Incidentally, the machine in its present form has Hurricane-type (or harmonium) rudder pedals, complete with built-in heel-rests. One does not appear to have quite the requisite degree of "feel" with these (feet are unfeeling enough as it is), and it is probable that the production trainer will be more normally equipped.

This trainer will be fitted with a Cirrus Minor, but the only performance change, in comparison with that of the Pobjoy-engined version, is likely to be a slightly less rapid take-off; with the geared Pobjoy this is remarkably short. The cruising speed will probably be almost the same. The indication with the present model, at 3,300 r.p.m., is 110-115 m.p.h., while the maximum seems to be in the region of 125 m.p.h.

There is nothing at all unconventional about the construction, which is of the stressed wooden skin variety, only the ailerons, rudder and elevator being fabric-covered. The wing has a single main box spar with an auxiliary rear spar, and, though it does not fold, the two outer sections can be detached simply and quickly for transport or storage purposes.

NEXT WEEK: FLIGHT

BRITISH AIRCRAFT INDUSTRY NUMBER

—containing detailed reviews of current civil and military types. This special issue (October 27), together with the Engines and Equipment Number of the following week (November 3), will form a work of reference which no one in the industry can afford to miss; the two issues will be equally valuable to all who pride themselves on being *au fait* with current practice.

FROM the CLUBS and SCHOOLS

LONDON

MESSRS. C. LEWIS-HALL and A. L. Crampton Chalk made their first solo flights last week, while Mr. A. Brine completed his "A" licence tests. A new member, Mr. P. A. Tyser, has joined the club. Over 58 hr. were flown.

LEICESTERSHIRE

The first club dance of the season will be held in the Clubhouse to-morrow, October 21, from 9 p.m. to 1 a.m. Tickets (at 5s. each) are obtainable from the secretary.

BARTON (BEDS)

Three new members, Messrs. J. S. Sproule, L. J. Fowler and W. D. Fry, have joined the club. Flying hours have been much reduced by the recent windy weather.

KARACHI

Flying hours during September reached the 200 hr. mark, with a total of 215 hr. 40 min. Three "A" licences have been received, while Mr. W. K. Sadhav has renewed his "B" licence.

BORDER

In common with other clubs, the strong winds during the first week in October seriously interfered with the club's flying activities. Up to last week-end only 14 hr. had been flown this month.

MARSHALL'S

During the past week the flying time for the school amounted to 60 hr. Several cross-country flights were undertaken, including visits to Croydon, Cardiff and Hanwell. Messrs. Osler and Clapin have joined the club.

READING

Improved weather conditions last week brought about a similar increase in flying time. Cross-country flights were made to Hanworth, Gloucester, South Cerney and Southend. The C.A.G. programme is now in full swing.

SHOREHAM

Mr. S. A. C. Sibley, a C.A.G. member, accomplished his first solo flight last Saturday. Quite a number of other C.A.G. trainees are now nearing the solo stage. The club's next social event will be the Four Club dinner at the Grosvenor House Hotel, London, on November 18.

HYDERABAD

During the month of September 75 new members joined the club, 54 of whom are learning to fly. The total flying time for the month amounted to 122 hr.

ROMFORD

Five members, Messrs. Fuller, Yates, Clough, Greenhill and Pearce, went on their first solo flights last week. Over 65 hours of instructional flying were flown between October 8 and 15.

REDHILL

The total flying time for last week amounted to 144 hr. Messrs. A. R. Jamieson, A. G. Friend, L. Dunsford and N. G. Durham made first solos, while Capts. J. V. Jellicoe and W. J. Henney, and G. E. Mason passed their "A" licence tests.

BROOKLANDS

A committee of eight members has been appointed to deal with the formation of the Brooklands Squadron of the Air Defence Cadet Corps. A staff of technical, practical and physical training instructors have agreed to give their services to the cause. Contact has been made with local A.R.P., Searchlight and Anti-Aircraft units. Fifty-six pupils of the club are now under instruction, eleven of whom have reached the solo stage. Mr. W. Kohler went solo last week, during which time 108 hr. were flown.

NORFOLK

During the month of September 225 hours were flown by the club. Quite a proportion of this time was done by those attending the Public Schools Aviation Camp, five of whom obtained licences. A series of gliding films will be exhibited shortly during the winter evenings. To-morrow, October 21, the annual ball will be held in premises erected on the tennis court. Special badges for C.A.G. members will shortly become available. Over 25 hr. were flown by members of this section of the club last week.

STRATHTAY

Gales and rainstorms seriously affected flying time during the first week of this month, only 24 hr. being recorded, of which the C.A.G. accounted for 15 hr. Two new members, Messrs. A. J. H. Stewart and Tilston, have joined the club. At the annual general meeting held last week, Messrs. M. C. Scarlett and D. F. Cargill were appointed to the committee in the place of two retiring members, Messrs. G. Young and G. C. Halley.

South Coast Celebration

OVER 200 members and friends turned up at the South Coast Flying Club's annual dinner and dance at the Grand Hotel, Brighton, last Saturday. Numbers alone are not always sufficient to ensure the success of such an affair, but those responsible saw to it that all the other necessary factors were present.

In the approved modern manner, speeches were few and brief. The chairman, Mr. Francis Haddock, reviewed the year's activities and proposed the toast of "The Guests."

Mrs. F. G. Miles replied and made some interesting references to the progress of the C.A.G. scheme, speaking in the light of her experience as one of the Commissioners. She then presented an impressive number of awards.

The guests included the Mayor of Brighton, the Mayor and Mayoress of Hove, Ald. Black (chairman of the Airport Committee and father of the late Tom Campbell Black), and Flt. Lt. Tommy Rose. Needless to say, there was a large and hearty contingent from Brooklands, headed by Capt. Duncan Davis.

In short it was just the right sort of party to set the seal on a successful year and provide a fitting send-off for what looks like being an even better one.

Ground Flying

"Teach Yourself to Fly," by Nigel Tangye; 2s. English Universities Press, Warwick Square, London, W.C.

ALTHOUGH, as Mr. Tangye is careful to explain in his introduction, it would be absurd to suggest that anyone can learn very much about the real business of flying by reading books, a sound basic knowledge of the whys and wherefores is always useful. Such knowledge may not appreciably shorten the period of dual instruction which is required before going solo, but it will give the embryo pilot the necessary knowledge of what is going on, and may at least save his instructor both throat trouble and apoplexy during the early stages. It is a curious, but nevertheless obstinate, fact that no pupil can ever hear what his instructor is telling him.

Now that so many people, both young and old, are learning to fly, it cannot reasonably be said that there are too many books on the subject. Actually, there are surprisingly few, and one of the very best was written and first published many years ago.

Mr. Tangye covers the process of learning to fly from the initial stages to the point at which the pupil is practising forced landings, making his first cross-country flights and learning something about aerobatics. There is certainly an air of realism about the book which is not always apparent in such cases; the author has the advantage of being not only a pilot, but a professional journalist. Such a remark as that in which he warns the pupil who is flying inverted for the first time that his legs will appear to be unreasonably heavy is just the sort which makes one feel that the author knows what he is talking about. *Teach Yourself to Fly* is illustrated in the customary manner with sketches showing the movements of the controls, the different attitudes of the machine and the appearance of the horizon from the point of view of the pilot. It is practically impossible to devise a means, least of all in semi-diagrammatical sketches, to show movements in three dimensions, and the artist in this case has done as well as any other.

In Palestine

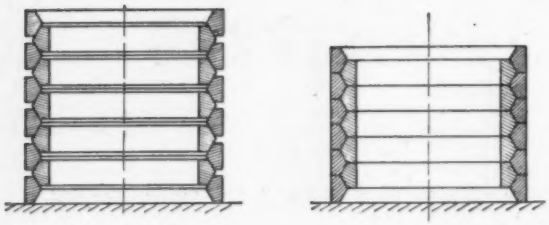
ALL arrangements concerning air touring in Palestine, including the issue of Carnets, have been taken over by the Automobile Club and Touring Association of Palestine, who are acting as the representatives of the Royal Aero Club. Their headquarters are in Princess Mary Avenue, Jerusalem.

Another American Trainer

FOR some time the development of a small tandem biplane known as the Western Pirate has been in progress at the works of Western Airmotive Corporation of Van Nuys, Calif. This company has recently been taken over by Phillips Aviation, and the machine has now been completed and is known as the Phillips CT-1.

This training type has now undergone its flight tests, and should shortly be obtaining its approved type certificate. The construction is fairly conventional, with a welded steel fuselage, wooden wing and fabric covering. The prototype is fitted with a B-4 Menasco 95 h.p., but any radial engine of similar power may be installed.

The company is now working on a light attack bomber for export, which will be powered either with a 420 h.p. Wright or a 450 h.p. Ranger twelve. It is an all-metal, low-wing, two- or three-seater carrying armament in the form of three machine guns and 300 lb. of bombs. The estimated performance figures of the Phillips XAB, as the machine is designated, are: Maximum speed, 205 m.p.h.; cruising speed, 180 m.p.h.; landing speed, 56 m.p.h.; rate of climb, 2,500ft./min.; and cruising range, 800 miles. The all-up weight will be 3,527 lb. and the weight when empty 2,167 lb.



A "DRY" UNDERCARRIAGE LEG

Low Weight and Absence of Maintenance Claimed for German Design

FROM Germany comes news of a type of undercarriage leg which appears to have certain practical advantages. Designed and manufactured by the "Kronprinz" Aktiengesellschaft für Metallindustrie, of Solingen, the leg may be said to be a modern version of the simple compression rubber type which was so much in vogue for light aeroplanes some years ago.

Fundamentally, the "Kronprinz" leg is based upon the use of stacks of concentric rings, of which the outer have their inner faces bevelled while the inner rings have their outer faces bevelled. When the load comes on the leg, these inclined planes slide on one another, and as a result the inner rings are compressed while the outer rings are expanded. The smaller drawing shows the rings in the two extreme positions.

Its Operation

Energy is absorbed by this sliding motion of the rings on their bevelled surfaces. Further energy is absorbed by the contraction of the inner rings and expansion of the outer rings. And, finally, that portion of the stack of rings which is at any given point of the stroke in contact with the restraining telescopic tubes is subject to friction, which also absorbs energy on the working stroke and checks bounce on the return stroke.

Owing to the fact that the horizontal surfaces of the rings make contact when the leg is fully compressed, the stress in the rings can be predetermined, and it is not possible to strain them. It is claimed that this fact results in a weight saving of about two-thirds, as compared with the usual spiral steel spring. As the inside of the leg is lubricated during assembly, maintenance during service is reduced to periodical inspection of the external parts.

The "Kronprinz" undercarriage leg is said to be particularly insensitive to climatic conditions and under tests has worked perfectly in temperatures of -70 deg. C.

The "Kronprinz" undercarriage leg uses neither air nor oil. Springing and damping are both effected by the two stacks of concentric rings. In this view the leg is shown in the unstressed position. At the top of the column are enlarged views of the rings "free" and compressed.

TWO MORE BOOKS

Popularising QBI

"Through the Overcast," by Assen Jordanoff; 12s. 6d. Funk and Wagnalls Co., 27a, Farringdon Street, London, E.C.4.

ONE of the most thorough books on instrument flying (American style) seems to us to have been almost spoilt by the manner of its presentation. That is one's first reaction to *Through the Overcast*, but this presentation, over-popular and somewhat exaggeratedly illustrated, is explained by the publisher's statement on the wrapper; in this the lay public is included among those who are expected to find the book useful and interesting.

Working through from weather problems and forecasting to a description of the various gyroscopic instruments and their uses, and to modern dead-reckoning and beam-flying technique, the book concludes with a useful chapter on celestial navigation, in which the basic principles are described simply and adequately with the help of drawings.

It is perhaps the illustrations, clear though they generally are, to which one tends to take exception. Excellent, if perhaps over-simplified, diagrams are sandwiched remorselessly between massive, almost jet-black sketches of various items of equipment, with an interspersion of unhumorous drawings of one "Cloudy Joe," a person who appears inexplicably throughout the descriptive matter.

But the book is thorough, and even the most knowledgeable expert may still learn something from the sections dealing with up-to-date instruments and devices. If of no other use *Through the Overcast* would make an ideal gift for young people who are interested in the whys and wherefores of modern transport flying. Anybody would be captivated, for instance, by the description of the sequence of operations during the take-off and climb to operating height, or during a descent in bad weather from this height down to aerodrome level. The technique described is not quite European, but it is nevertheless useful.

Aerodrome Planning

"Aerodromes: Their Location, Operation and Design," translated from the German; 10s. 6d. Pitmans.

APART from official material and, more recently, a book on the subject issued by the Indian Directorate of Civil Aviation, the problems involved in aerodrome design have not been given a great deal of prominence. The subject is a specialised one, and those concerned with it have not so far considered it worth-while to publish their opinions and conclusions in book form.

It has been necessary for Pitmans, in fact, to go to Germany for the information in the most recent book in their Air Transport series. This book deals not with the operation of aerodromes, but with the problems which must be considered when the position for a new aerodrome is being decided upon, and when its size and layout are being planned.

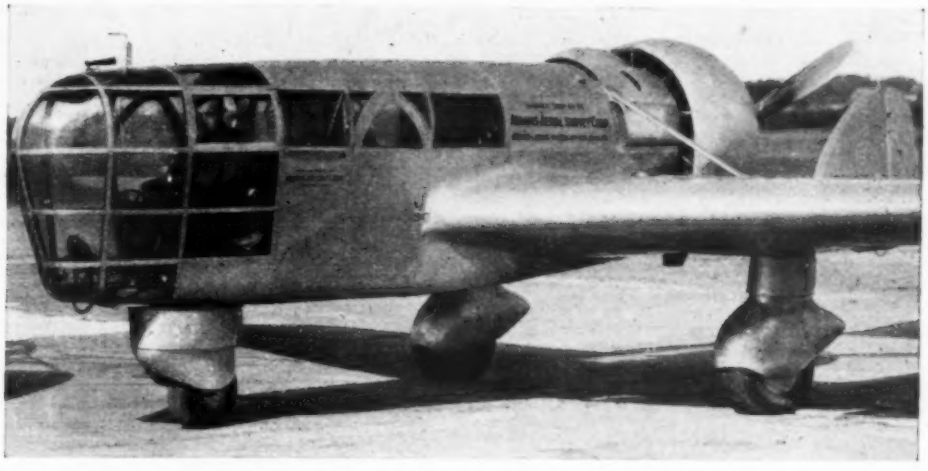
The volume is in two parts, the first dealing with location problems (by Prof. Carl Pirath) and the second with the planning of the aerodrome once the position has been settled (by Karl Gerlagh). Both sections consist of the results of researches made by the Scientific Institute for Air Transport at Stuttgart.

A great deal of attention is paid to the direction of the prevailing winds in various parts of Europe, and statistics are given to show the number of days in the different months of the year during which various airports are being operated under what are usually known as QDM conditions. As a matter of interest it appears that, at least during the period of the survey, Amsterdam suffered the greatest number of bad days, with Warsaw next and London (Croydon) following. The latter suffered 203 QBI days, though it must be explained that the conditions were noted in the early morning. Berlin, by contrast, suffered only 87 difficult days, a figure which helps to explain the remarkable record of safety at Tempelhof, the approaches to which are made more difficult by the fact that it is located practically in the centre of the city.

In the second section of the book the various design requirements of aerodromes dealing with the different types and amounts of traffic are considered, and the problem of runway layout examined. Additionally, suggestions for suitable building arrangements to permit of rapid traffic clearance are made, and the importance of road communications are stressed. The plans given of projected and existing terminal building layouts, in relation to other diagrammatical plans to show the order in which various arrival and departure procedures should efficiently be carried out, make interesting comparisons.

SURVEY SPECIAL

The Abrams Explorer and its Equipment



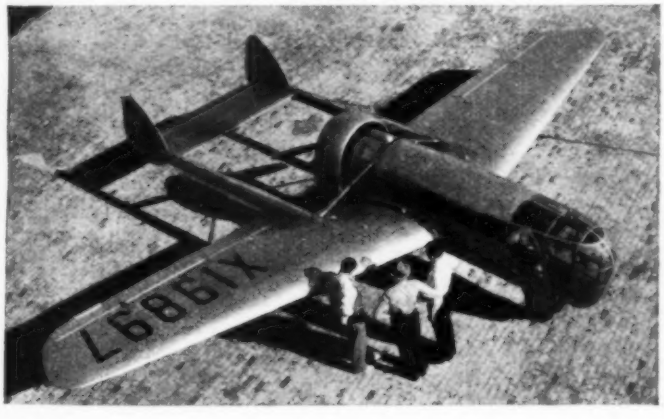
At first glance the Explorer suggests something new in military aircraft.

THOUGH aircraft built specially for survey work are no novelty—the Gloster survey machine, for instance, has performed faithful and efficient work since it was produced many years ago—there can never have been such a striking example of specialised design as the Abrams monoplane illustrated here.

In an effort to keep abreast or ahead of their competitors in the aerial mapping field, the Abrams Aerial Survey Corporation, of Lansing, Mich., designed and built the Explorer, and the outcome was considered so successful that a company, the Abrams Aircraft Corporation, was formed to put the job into production.

The prototype was described in *Flight* early this year, but it is now possible to give further details. The engine in the production type is a supercharged 450 h.p. Wright Whirlwind. The pusher arrangement, the sweep-back of the leading edge, and the almost completely transparent nose are all features intended to give maximum "visibility" forward and downward. Construction is stressed aluminium alloy skin, with monocoque tail booms.

Designed for high-altitude operation when required—the figure mentioned is 30,000ft., which, of course, would allow survey photography only in exceptional weather—the Explorer carries special oxygen equipment for its crew of two; a pressure cabin was hinted at in the original specifications, but presumably this has been abandoned.



The swept-back leading edge assists "visibility."

For use in the machine the company has evolved a camera which is claimed to be a long way ahead of existing types. It is said to carry sufficient film for 600 exposures—a 500ft. roll—and is made entirely of Dow metal, a magnesium alloy; its weight is 67 lb., loaded.

The Explorer, it seems, has a higher performance than its appearance would suggest. Maximum speed at sea-level is 210 m.p.h., and at 20,000ft. 260 m.p.h. Rate of climb is 2,600ft./min., service ceiling 36,000ft., range 2,000 miles, and landing speed 58 m.p.h.

Forthcoming Events

OCTOBER

Thurs., 20th. R.Ae.S. Lecture*: "Light Alloys in Aircraft Construction," by M. le Coeuvre.

Thurs., 20th. R.Ae.S. Coventry Branch Lecture: "Inspection of Aero Engines," by R. G. Underwood.

Thurs., 20th. R.Ae.S. Portsmouth Branch Lecture: "Long-distance Flying," by F/O A. E. Clouston, A.F.C.; 7.30 p.m., Airspeed Social Club, Copnor.

Fri., 21st. Norfolk and Norwich Aero Club: Annual Ball, Norwich Municipal Aerodrome.

Tues., 25th. R.Ae.S. Students' Section Lecture†: "Wings and Control Surfaces," by D. L. Ellis, B.Sc., A.R.T.C., A.F.R.Ae.S.

Tues., 25th. R.Ae.S. Isle of Wight Branch Lecture: "Mechanical Testing of Aircraft Structure," by A. W. Clegg, B.Sc., A.F.R.Ae.S.

NOVEMBER

Thurs., 3rd. R.Ae.S. Lecture*: "The Meteorological Problem of the North Atlantic," by Capt. F. Entwistle, B.Sc.

Tues., 8th. R.Ae.S. Students' Section Lecture†: "Wind Tunnels," by E. A. Wright.

Tues., 8th. R.Ae.S. Isle of Wight Branch Lecture: "Aircraft Instruments," by Sqn. Ldr. Saker.

NOVEMBER (Cont.)

Wed., 9th. R.Ae.S. Lecture*: "American Aircraft," by T. P Wright, F.I.Ae.S., F.R.Ae.S.

Thurs., 17th. R.Ae.S. Lecture*: "The Work of the D.V.L.," by Dr. F. Seewald.

Fri., 18th. Brooklands Four-club Annual Dinner and Dance, Grosvenor House, London.

Tues., 22nd. R.Ae.S. Students' Section Lecture†: "Meteorology," by F. Entwistle, B.Sc.

Tues., 22nd. R.Ae.S. Isle of Wight Branch Lecture: "Future Development of Aircraft Construction," by Dr. Roxbee Cox.

Fri., 25th. Strathtay Aero Club: Annual Ball, Salutation Hotel, Perth.

Fri., 25th-Sun., Dec. 11th. Paris Aero Show, with Air Transport Congress.

Tues., 29th. Institute of Transport: Brancker Memorial Lecture—"Development of Air Mail," by Capt. D. O. Lumley O.B.E.; 6.30 p.m., Institution of Electrical Engineers, Victoria Embankment, London, W.C.2.

* All these lectures take place at 6.30 p.m., at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.
† All these lectures take place at 7 p.m. in the R.Ae.S. Library, 7, Albemarle Street, London W.1.

THE INDUSTRY

Death of Sir Henry Fowler

IT is with sincere regret that *Flight* records the death, at the age of 68, of Sir Henry Fowler at his home at Spondon, near Derby, last Sunday. Although chiefly known for his great engineering achievements in locomotive engineering, Sir Henry Fowler did good work for aviation as Superintendent of the Royal Aircraft Factory (as it then was) at Farnborough.

Works Lighting

RECENT orders for G.E.C. works lighting equipment include 207ft. of Osira fluorescent tubing for office lighting at the Airscrew Company's Weybridge plant and fluorescent lamps and fittings for Airspeed, Ltd., at Portsmouth.

Mr. Holman's New Post

HIS many friends in the aircraft industry will be interested to learn that Mr. V. Holman has resigned from Automotive Products, Ltd., and has taken up the position of manager of the Aeronautical Department of the Sperry Gyroscope Co., Ltd. Mr. Holman began his new duties last week.

Electric Motors

A NEW type of patented squirrel-cage electric motor which, while requiring an unusually low starting current, retains the extreme simplicity of that variety of motor, has been produced by Higgs Motors, Ltd., Witton, Birmingham, 8, and is described in a catalogue.

Home-produced Oil

DURING the past few weeks extensive production tests have been carried out on the test well drilled by the Anglo-American Oil Company at Dalkeith, Scotland. Four sands from 2,000ft. to 2,152ft. gave a combined natural gas production of 5,000,000 cubic feet per day, with a shut-in pressure of 700 lb. sq./in. These sands were temporarily plugged off, and a further test was conducted on the oil sands at 1,750ft. Over a five days' period the rate of production averaged eight to ten barrels of oil per day.

Towards Safety

FIRE-FIGHTING and first-aid apparatus, A.R.P. equipment and aircraft crash equipment are described in detail in a new catalogue entitled "National Safety," and issued by the National Fire Protection Co., Ltd., Petersham Road, Richmond, Surrey.

Eelectricity

QUITE one of the most original Motor Show exhibits at Earls Court is an eel—more precisely, an electric eel from the Amazon. It is "alive" in every sense of the term and can transmit dangerous shocks.

The Exide battery people are responsible for importing this pleasant little fellow, and they are demonstrating his potentialities by means of a cathode-ray oscilloscope, neon lamps and so forth. The story behind the bright idea is that the Exide battery—made for cars, aircraft and other purposes—behaves in much the same fashion, i.e., it will keep supplying current even when entirely submerged under water.

Machine-tool Training in Birmingham

E. H. JONES (Machine Tools), Ltd., Edgware Road, The Hyde, London, N.W.9, state that, as a result of the success of the Thiel Training Centre held at their London showrooms last March, they have decided to arrange similar training facilities in Birmingham during November. Full training facilities will be available from November 15 to November 29 inclusive.

The complete range of Thiel tool-room machines, including reciprocating filing and sawing machines, bandsawing machines, combination reciprocating filing and sawing machines with bandsawing attachment, punch shaping machines, tool and punch millers, tapping machines, etc., will be installed at the firm's Birmingham showrooms, 14, Florence Street, Birmingham, 1.

It is stated that during the period March 29 to April 12, 97 firms, represented by 172 operatives, took advantage of the training facilities in London.

NEW COMPANIES

In the notes below, for reasons of space, the "objects" of new companies are usually somewhat abbreviated.

AUTO AND AERO SHEET METALS LTD.—Private company, registered September 24. Capital £100 in 100 shares of £1 each. Objects: To carry on business as sheet metal workers, etc. The subscribers are John Holcroft and Victor J. Holcroft, of 11, Stoneleigh Road, Kenilworth. John Holcroft to be permanent director.

GRIMSBY AVIATION LTD.—Private company, registered September 30. Capital, £100 in 100 shares of £1 each. Objects: to carry on the business of flying instructors; and to promote the study of aerial navigation and aeronautics, etc. The permanent directors are Roger Frogley, Arthur R. Frogley, Gerard W. Frogley, Frank E. Darlow (all directors of Herts and Essex Aero Club, Ltd.). Registered office: 329, High Holborn, London, W.C.1.

ANGLO-AMERICAN AERONAUTIC ASSOCIATION LTD.—Private company, registered October 4. Capital, £500 in 500 shares of £1 each. Objects: to carry on the business of manufacturers, repairers, cleaners, storers and warehousers of and dealers in aircraft of all kinds, watercraft, etc. The directors are Franz L. Daschek, Wm. S. B. Moss, Count Franz B. Schoenborn-Buchheim. Registered office: 75/77, Shaftesbury Avenue, London, W.1.

CRAWLEY AIRCRAFT AND PRECISION TOOL COMPANY, LTD.—Private company, registered September 29. Capital, £100 in 100 ordinary shares of £1 each. Objects: to carry on the business of manufacturers of aeroplane and other tools, press tool makers for the construction of aircraft, etc. The directors are: Frank H. Ayling and Thomas C. Greenhough. Registered office: Precision Works, London Road, Crawley, Surrey.

BRISTOL GLIDING CLUB PROPRIETARY LTD.—Private company, registered September 26. Capital, £100 in 100 shares of £1 each. Objects: to promote gliding, soaring and aerial navigation in all its forms, and the study of aeronautics, etc. The first directors are Richard A. Cocke, Michael H. Maufe, Keith W. Turner. Registered office: Hambrook House, Hambrook, Bristol.

AIR MAPS & PLANS LTD.—Private company, registered October 4. Capital, £100 in 100 shares of £1 each. Objects: to secure and carry out contracts in any part of the world for the preparation of maps and plans from photographs taken from the air and ground survey, etc. The first directors are to be appointed by the subscribers. Solicitors: Stoneham & Sons, 108a, Cannon Street, London, E.C.4.

AERONAUTICAL PATENT SPECIFICATIONS

(The numbers in brackets are those under which the Specifications will be printed and abridged, etc.)

(*Published October* 13, 1938).

33975. COBHAM, Sir A. J., JOHNSON, H. C., ALLISON, P. R., and FLIGHT REFUELLING, LTD.: Method of and apparatus for refuelling aircraft in the air (491,953).
7511 ROTH, L., and GOLDE, H.: Screw propeller, particularly for aircraft (492,175).
7596 MOSS, D. G. K., and PEIRCE, H. C.: Gyroscopic navigation instruments (492,184).
7664 ROTH, L., and GOLDE, H.: Screw propellers, particularly for aircraft (492,273).
7821. UNITED AIRCRAFT CORPORATION: Mechanics' platforms for aircraft (492,290).
7838. AUTOMOTIVE PRODUCTS CO., LTD., and GATES, G. R. C.: Electric switches actuated by fluid pressure (492,293).
7907. SPURR, E.: Hydroplanes, seaplane floats, flying-boat hulls and other high-speed water-craft (492,046).
7960. SHORT BROS. (ROCHESTER AND BEDFORD), LTD., and MCVIE, R.: Air brakes for aircraft (492,300).
8127. AC-SPHINX SPARKING PLUG CO., LTD., and CORBIN, D. H.: Manufacture of spark plugs (492,315).
8262. SOC. NOBEL FRANCAISE: Compositions for coating aeroplane fabrics (492,133).
12077. ARROW AIRCRAFT, LTD., and HINDLE, A.: Metal containers or chambers for use in dropping supplies from aircraft (491,984).
15345. AC-SPHINX SPARKING PLUG CO., LTD., and CORBIN, D. H.: Spark plugs (492,069).
25743. PAINE, H. SCOTT-: Lifting and lowering slings (492,127).
31893. LORENZ AKT.-GES., C.: High-frequency signalling systems (492,006).
36155. SOC. FRANCAISE RADIO-ELECTRIQUE: Directional radio receivers (492,011).
2152. FOCKE, H.: Rotors for rotating wing aircraft (492,013).
5079. TINSSONNIER, G.: Parachute and method of manufacturing same (492,140).
5554. HENSCHEL FLUGZEUG-WERKE AKT.-GES: Driving device for drophammers (492,243).
5734. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES.: Observing instruments for air craft (492,020).
7221. BRISTOL AEROPLANE CO., LTD., FEDDEN, A. H. R., and KYLENOT E.: Apparatus for automatically regulating the temperature of internal combustion engines (491,933).
29747. BENDIX AVIATION CORPORATION: Brakes (491,631).
31399. MERCIER, J.: Sealing device for pistons, stuffing-boxes, shock-absorbers, and the like and its various applications (491,763).

(*Published October* 20, 1938.)

8336. BLACKBURN AIRCRAFT, LTD., and BAILEY, H.: Means for temporarily securing two or more plates or other parts together (492,607).
8198. LORENZ AKT.-GES., C.: Seals for electric discharge vessels (492,659).
8530. DOWTY, G. H.: Means for equalising or balancing the operation of aircraft flaps, retractable undercarriages or other adjustable aircraft elements (492,669).
8562. HILLIER, A (Sperry Gyroscope Co., Inc.): Gyroscopic apparatus (492,670).
8784. ECLIPSE AVIATION CORPORATION: Dynamo-electric machines (492,682).
15871. FAIREY AVIATION CO., LTD., LOBELLE, M. J. O., and TROTTER, J. C.: Aircraft landing-gear (492,545).
24491. SPERRY GYROSCOPE CO., INC.: Gyro-verticals (492,707).
25138. LINDE AIR PRODUCTS CO.: Portable gas-cutting and like machines (492,559).
26981. MASCHINENFABRIK OERLIKON: Electric gas-blast switches (492,434).
29515. ARCHIBALD, R. H.: Rate of climb indicating and/or recording instruments (492,563).
8605. BREWER, G. (Krupp Akt.-Ges, F.): Armoured Turrets (492,583).
6852. LORENZ AKT.-GES., C.: Shielding arrangements for high-frequency thermionic tube devices (492,641).
10729. TELEFUNKEN GES. FUR DRAHTLOSE TELEGRAPHIE: Direction-finding radio-receiver systems (492,643).

THE AIRCRAFT ENGINEER

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CHANGING OVER TO "BOOTS"

Some Notes on the Conversion of Landplane to Seaplane

By H. PARKINSON, A.M.I.Ae.E.

THERE is very little demand in this country for float seaplanes, apart from military aircraft, but it is a fact that most of our successful landplanes below an all-up weight of 8,000 lb. make at least a design-office appearance in seaplane form.

The output of new types is steadily increasing, and one may reasonably expect that the marine versions of these will be receiving consideration for purpose of tender or in connection with enquiries. Those who are unfamiliar with conversion problems will no doubt be primarily interested in producing the tentative marine counterpart with a minimum of research into the various data available. Much of this initial work would finally be of little interest, and with this in mind it is intended to present the essential information which will cover a preliminary investigation.

Certain formulæ, etc., are quoted without explanation and readers who are interested in the derivation of this information are asked to refer to previous articles, Refs. 1, 2 and 3, which have appeared in these pages.

The location of the floats in relation to the aircraft structure is a basic problem in hydrostatics, which one has found to cause infinitely more trouble than certain complex problems which are often handled without more than a casual introduction.

Referring to Fig. 1A, it is seen that the body is in a state of equilibrium in that the weight of the body is vertically opposed to a numerically equal load (force of buoyancy) acting through the centre of buoyancy.

In Fig. 1B the body is displaced by some external force and is subjected to a moment of magnitude WZ (righting moment), which will initially start the body moving back to the position shown in Fig. 1A.

If it is required to float the body at any angle α (Fig. 1C) it will be necessary to add a weight "w" such that the c.g and c.b. are vertically above each other. Thus, in the case of the seaplane it is necessary to predetermine the attitude of the machine when at rest, the basic data required being that of estimating the c.b. of the flotation system, together with the c.g. of the completed aircraft. This will be dealt with later.

Float Shape.—In common with the advances in general layout and design of aircraft as a whole, the seaplane float has also developed along certain lines, and the float shown in Fig. 2 is representative of modern British practice. All the characteristics quoted herein are based on this model.

The float beam is given by:

$$\text{Beam (maximum) inches} = 2.01 \sqrt[3]{\Delta T} \quad .. \quad .. \quad (1)$$

where ΔT = total displacement of one float in lb.

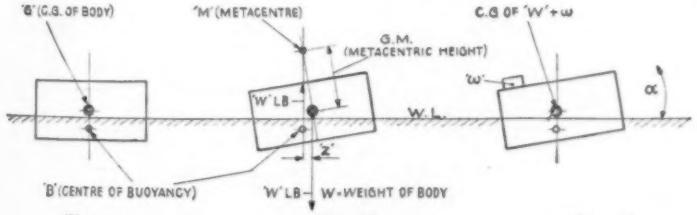


Fig. 1A Fig. 1B Fig. 1C

Flotation data.

On the right, Fig. 3, midship section.

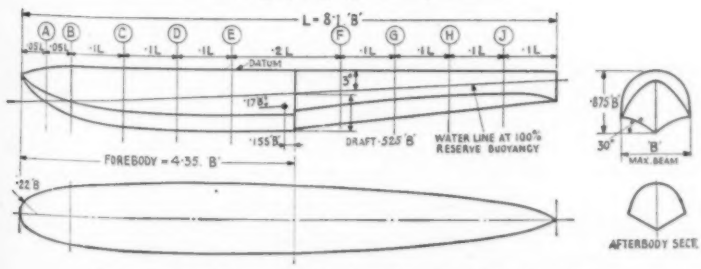
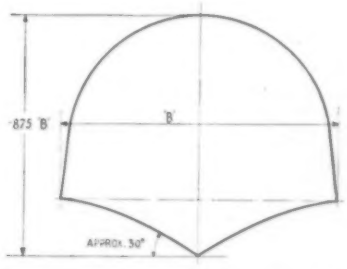


Fig. 2. Float Shape. Ordinates given in Table A, p. 68.



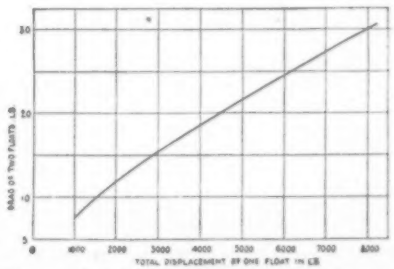


Fig. 4. Aerodynamic drag of twin floats at 100ft. per sec.

The total displacement is a function of the reserve buoyancy which must be not less than 100 per cent. (Ref. 4). The minimum requirement therefore demands that the fully submerged displacement of one float be equal to the maximum all-up weight of the aircraft. It should be noted that the percentage of reserve buoyancy is defined as :

$$\frac{100(2\Delta T - W)}{W}; \quad W = \text{gross weight of seaplane.}$$

Incidentally, to those who are interested in the manufacturing aspect, it is seldom desirable to build floats with a minimum reserve buoyancy of 100 per cent. for the prototypes. Subsequent increases in engine power, together with developments, tend to increase the gross weight, which means that the original jigs and fixtures will probably be scrapped. Unless a machine is designed

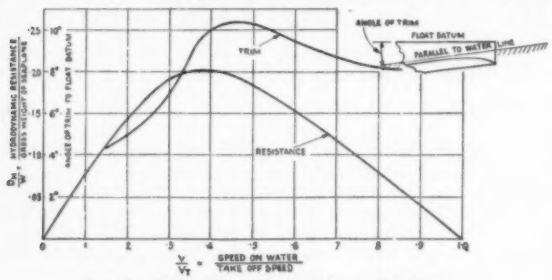


Fig. 5. Hydrodynamic data for twin floats.

for racing purposes it is desirable to design for a reserve buoyancy of 10 per cent. to 15 per cent. above the minimum requirements. Within these limits the extra weight and drag will be comparatively small. See Figs. 4, 10 and 11.

The basic float is dimensioned in terms of the maximum beam, and the required ordinates may be computed following the solution of the expression for beam.

Position of water-line and C.B.—In Fig. 2, the positions of the water-line and centre of buoyancy are shown for a reserve buoyancy of 100 per cent. The angle of the water line to the deck varies slightly with independent designs, but the value of 3 deg. may be taken as an average.

Setting of floats relative to aircraft.—The angular setting of the floats relative to the machine datum is a function of the wing characteristics at take-off speed combined

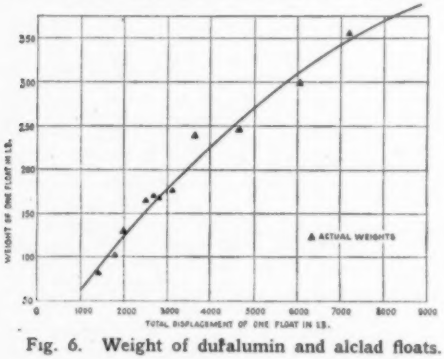


Fig. 6. Weight of dufalumin and alclad floats.

with the hydrodynamic performance of the flotation gear.

If the machine were designed to take off without elevator control, it would be necessary to design for the wing incidence which gives the optimum value of K_L at the take-off. The general practice, however, is to give the pilot approximately 2 deg. control over the fully air-borne condition.

Reference to Fig. 5 shows that the floats squat at approximately 8 deg. to the datum (deck of float) near take-off. The expression for setting is then

$$\theta = \phi - (8^\circ + 2^\circ + \alpha) \quad .. \quad .. \quad .. \quad (2)$$

where

θ = angle between float datum and machine datum.
ϕ = stalling angle of wing.
α = wing incidence to machine datum.

This setting is also governed, particularly in small machines, by the proximity of the tail unit to the water-line. A wing section having a large stalling angle would make the ideal float setting prohibitive, due to the tail being swamped during take-off. A setting angle of 3½ deg. is the maximum which one has seen in practice.

Airscrew water clearance.—A minimum of two feet is advisable, but this can be increased on certain types. Should the seaplane have a longitudinal metacentric height much in excess of the minimum requirement, it would be policy to give the airscrew clearance the benefit of the doubt.

Metacentric heights.—Fig. 1B defines the metacentric height. This is a measure of the statical stability, and experience has shown that the minimum values are :

$$\text{Longitudinal GM} = 1.5\sqrt[3]{\Delta}\text{ ft.} \quad .. \quad .. \quad (3)$$

$$\text{Transverse GM} = 1\sqrt{\Delta}\text{ ft.} \quad .. \quad .. \quad .. \quad (4)$$

Where Δ = total displacement in lb., i.e., gross weight of machine.

In seaplanes the G.M. is a maximum for a small increment of trim, and decreases as the angle of trim increases. The former is the condition which must satisfy the quantities given by these expressions for G.M.

In normal seaplanes, the float shown in Fig. 2 will be found to satisfy the requirements of longitudinal G.M.

The magnitude of the longitudinal G.M. can be checked as follows :

$$\text{B.M.} = \frac{\text{I.L.F.}}{V} \text{ (Ref. 6)} \quad .. \quad .. \quad .. \quad .. \quad (5)$$

Where : BM is the distance between the c.b. and c.g.
I.L.F. is the longitudinal moment of inertia of the two water planes.
V is the total displacement in cu. ft.

and

$$\text{I.L.F.} = (0.039L^3B)2 \quad .. \quad .. \quad .. \quad .. \quad (6)$$

L = overall length of float.
B = maximum beam.

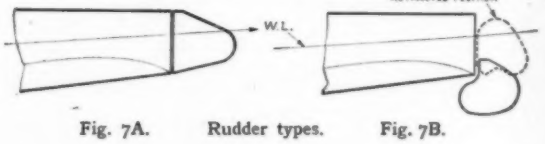


Fig. 7A. Rudder types. Fig. 7B.

It will be unnecessary to calculate the transverse B.M. as this is automatically fixed when solving the expression for track.

Track of Floats.—$$\text{Track} = \sqrt{\frac{\text{BM} \times \text{B}}{0.85}} \quad .. \quad .. \quad (7)$$

BM (see Fig. 1) = BG + GM. BG is fixed when positioning the floats on the side elevation of the arrangement drawing of the machine. G.M. is obtained from (4).

Float weights and c.g. position.—The weights shown in Fig. 6 are for floats constructed in duralumin or alclad. This curve is representative of the actual weights of a number of British and foreign floats.

The c.g. of a float may be taken as 0.45 of the overall length measured from the bow, and 0.58 of the maximum depth measured vertically below the deck.

C.G. of complete seaplane.—The relative c.g. positions of seaplane and landplane are such that the former is slightly lower and forward of that determined for the landplane. It is convenient to use the landplane c.g. for purposes of an initial estimate of the float position.

Aerodynamic resistance of floats.—The drag of the float shown in Fig. 2 is 2.15 lb. per square foot of frontal area at 100 feet per second.

Fig. 3 shows the maximum cross section of the float, the area of which is given by :

$$\text{Area} = 0.62B^2.$$

Drag of twin floats at 100 feet per second, in terms of the total displacement of one float, is represented in Fig. 4

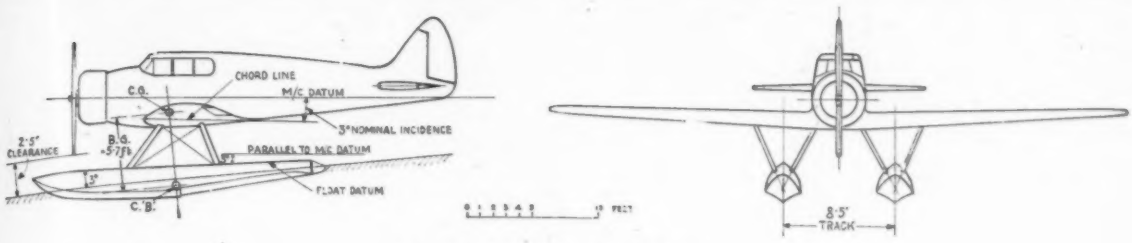


Fig. 8. Arrangement of seaplane.

Hydrodynamic data.—These data are a variable of the aerodynamic properties of the seaplane, and independent designs fitted with floats of similar form can be expected to show different characteristics.

Fig. 5 represents average values of float attitude and hydrodynamic resistance at various speeds over the take-off. It is presented on a basis which permits the construction of the curves to suit the gross weights and take-off speeds of particular seaplanes.

Design of rudder.—An empirical figure for rudder area is given by

$$\frac{A \times l}{V} = 0.47$$

Where

A = Total area of one rudder.

l = distance from centre of buoyancy to rudder hinge

V = Displacement, in cubic feet, of one float to load water-line.

$$\left(\frac{\text{Gross weight of machine}}{128}\right)$$

Rudder types are shown in Fig. 7. Type 7A is less efficient than type 7B due to interference from water flow. The manufacturers of "EDO" floats (U.S.A.) have for a number of years used the type of rudder which may be retracted by means of a control in the cockpit.

With type 7B it is desirable to provide a method of retraction, which can at least be handled by the beaching staff, in order to prevent damage during beaching operations.

Application of Data

Following is an analysis of the seaplane shown in Fig. 8.

Particulars.—Gross weight 4,000 lb. (estimated from Fig. 6 + .025W for chassis struts). Wing incidence to machine datum 3 deg. Stalling angle of wing 18 deg. Reserve buoyancy of flotation system 100 per cent.

Max. float beam.—$B = 2.01^3\sqrt{4000} = 31.8$in. from (1).

Float shape and positions of C.B. and water-line.—From Fig. 2 and table A. Length of float = 8.1 × 31.8in. = 21.4ft.

Float position relative to machine.—$\theta = 18 - (8° + 2° + 3) = 5°$ from (2). As 5 deg. is excessive, an angle of 3 deg. is chosen. Wing incidence at take-off is therefore 16 deg.

Take-off speed.—Estimated at 90 feet per second.

Metacentric heights.—Required longitudinal G.M. = $1.5^3\sqrt{4000} = 23.8$ft. from (3).

Actual longitudinal G.M. = $\left(\frac{0.078 \times 21.4^3 \times 2.65}{62.5}\right)$ − B.G. from (5) and (6)

B.G. (from Fig. 8) = 5.7ft.

G.M. = 32.4 − 5.7ft. = 26.7ft.

This satisfies the minimum requirement.

Required transverse G.M. = $\sqrt[3]{4{,}000} = 15.9$ft. from (4).

It is unnecessary to calculate the actual transverse G.M. as this requirement is satisfied when solving for track.

$$\text{Track} = \sqrt{\frac{21.6 \times 2.65}{0.85}} = 8.25\text{ft. from (7).}$$

As 8.25ft. is the track required to meet the minimum G.M. requirement, it will be advisable to increase this figure to 8.5ft.

Hydrodynamic resistance and float attitude.—These data

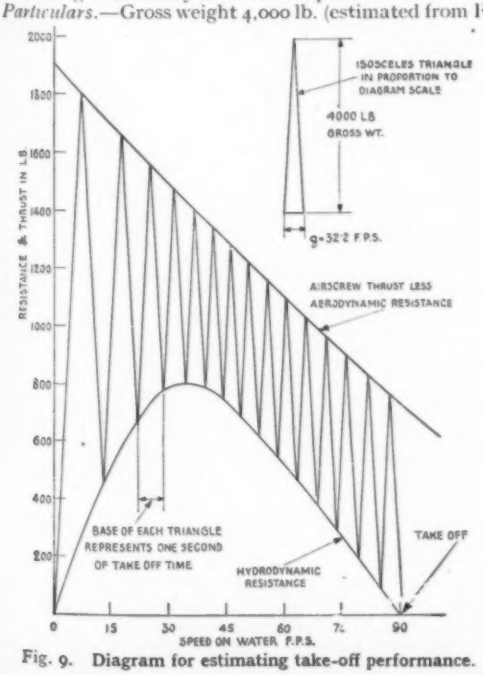


Fig. 9. Diagram for estimating take-off performance.

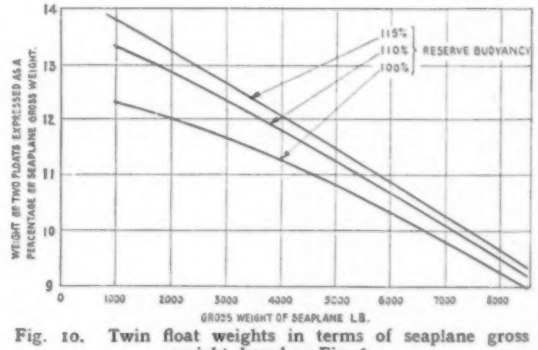


Fig. 10. Twin float weights in terms of seaplane gross weight, based on Fig. 6.

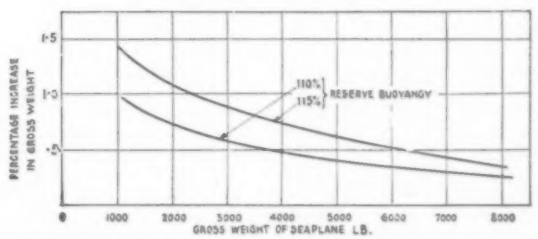


Fig. 11. Effect of increase in reserve buoyancy on gross weight of machine. 100 per cent. reserve buoyancy as parameter.

are estimated from Fig. 5, and the resistance is plotted on Fig. 9. The aerodynamic resistance has been estimated in conjunction with information obtained from the trim curve. This is deducted from the airscrew thrust at various speeds, and is also plotted on Fig. 9.

Take-off time and run.—This is obtained by the method of Ref. 3. From Fig. 9 take-off time = 15 seconds approx.

The length of run required for take-off is given by the sum of the mean speeds for each second from start to take-off.

No. of Seconds from Start.	'V' at End of Each Second.	Mean 'V' = V1.	Distance moved = V1.t
1	13	6.5	6.5
2	22	17.5	17.5
3	28	25.0	25.0
4	34	31.0	31.0
5	39	36.5	36.5
6	43	41.0	41.0
7	49	46.0	46.0
8	53	51.0	51.0
9	58	55.5	55.5
10	63	60.5	60.5
11	68	65.5	65.5
12	73	70.5	70.5
13	79	76.0	76.0
14	84	81.5	81.5
15	90	87.0	87.0
		Total ..	751.0 feet

$\therefore$ Length of run $= \frac{751}{3} = 250$ yards.

Take-off time and run have been estimated for zero wind.

The effect of wind on take-off performance is an important aspect which is treated fully in Ref. 5.

TABLE A.—ORDINATES FOR FLOAT SHOWN IN FIG. 2.

Except for Column 2 the Ordinates are given in Terms of Max. Beam.					
Station.	**Distance from Bow.**	**Deck below Datum.**	**Chine below Datum.**	**Keel below Datum.**	**Half Breadth at Chine.**
Bow	0	.14	.14	.14	0
A	.05 'L'	.05	.36	.54	.32
B	.1 'L'	0	.48	.69	.39
C	.2 'L'	0	.60	.81	.475
D	.3 'L'	0	.65	.85	.50
E	.4 'L'	0	.66	.875	.50
Step Ford.	.537 'L'	0	.63	.85	.48
Step Aft	.537 'L'	0	.58	.82	—
F	.6 'L'	0	.50	Straight	.46
G	.7 'L'	0	.42		.41
H	.8 'L'	0	.36		.34
J	.9 'L'	0	.31		.25
Stern	'L'	0	.41	.41	0

REFERENCES

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2. Notes on the design of twin seaplane floats. H. Parkinson. *Aircraft Engineer*, Feb., 1933.

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THE SLOPE OF THE LIFT CURVE

By W. R. ANDREWS, A.F.R.Ae.S.

THE present article is a monograph showing that the slope of the lift curve of a rectangular wing is practically a constant fraction of that of an elliptical wing of the same aspect ratio. From this it is concluded that for any given plan form of wing the slope is readily obtained from that of the elliptical wing by the use of a suitable reduction factor. The numerical value of this factor will always be less than unity.

The elliptical wing represents the aerodynamic ideal. For a given thickness and aspect ratios the slope of the lift

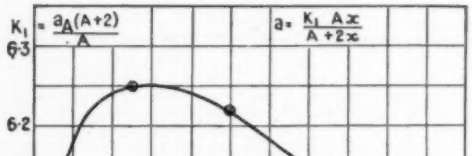

Fig. 1. Straight-tapered wings.

curve is the maximum obtainable and the induced, or aerodynamic, drag is a minimum.

In making the correction from one aspect ratio to another it is convenient to determine the change in incidence at which the same lift coefficient is realised. Thus the difference between the angle for an infinite wing and that for aspect ratio = A is given by

$$\alpha_A - \alpha_0 = \frac{C_L}{\pi A}(1+\tau) \quad .. \quad .. \quad .. \quad .. \quad (1)$$

where α_A and α_0 are the angles of incidence of wings of aspect A and Infinity respectively.

C_L = Lift Coefficient.

A = Aspect Ratio = Span²/Area.

τ = Constant varying with plan form and A/a_0 where $a_0 = \frac{dC_L}{d\alpha}$ for infinite wing

= 0 for an elliptical wing for all values of Aspect Ratio.

Letting $a_A\alpha_A = C_L = a_0\alpha_0$ and substituting in (1) gives

$$\frac{1}{a_A} - \frac{1}{a_0} = \frac{1}{\pi . A .}(1+\tau)$$

$$\therefore a_A = \frac{\pi . A . a_0 .}{a_0(1+\tau) + \pi . A}$$

$$\text{or } a_A = \frac{A}{\frac{1+\tau}{\pi} + \frac{A}{a_0}}$$

The theoretical value for a_0 is 2π, but the actual value is usually smaller than this, so that in general we may write $a_0 = 2 . \pi . x$ where x is the reduction factor and is mainly a function of the thickness/chord ratio

$$\text{then } a_A = \frac{2 . \pi . x . A}{A + 2(1+\tau) . x} \quad .. \quad .. \quad .. \quad .. \quad (2)$$

which for an elliptical wing when $\tau = 0$ resolves to

$$a_A = \frac{2 . \pi . x . A}{A + 2 . x} \quad .. \quad .. \quad .. \quad .. \quad (3)$$

The theoretical value for an elliptical wing when $x = 1.0$ is

$$a_A = \frac{2 \cdot \pi \cdot A}{A + 2} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (4)$$

Glauert (Ref. 1) gives the theoretical values for the total lift on a rectangular aerofoil in the form of a constant A_1

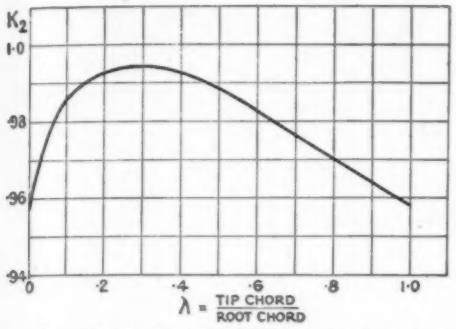

Fig. 2. Correction factor to be applied to the slope of the lift curve for an elliptical wing to obtain that of rectangular or straight-tapered wings.

dependent upon aspect ratio from which the slope of the lift curve is obtained, as under

$$a_A = \frac{\pi}{2} \cdot A \cdot \left(\frac{A_1}{\alpha}\right) \alpha \quad .. \quad .. \quad .. \quad .. \quad (5)$$

The numerical values of $\frac{A_1}{\alpha}$ have been obtained when $\alpha = 1$ Radian so that resulting slope is per radian.

Incidentally equation 5 and the data have been modified to agree with the now accepted lift coefficient C_L instead

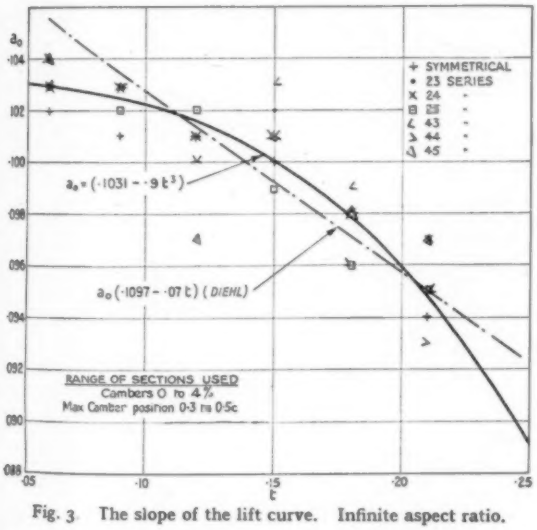

Fig. 3. The slope of the lift curve. Infinite aspect ratio.

of K_L as used by Glauert. A_1 is actually the first term of the Fourier series representing the spanwise loading of the aerofoil.

The value $\frac{A_1}{\alpha}$ is used for tapered aerofoils at a given value of $\frac{A}{a_0} = 1.0$, but for rectangular aerofoils of varying aspect ratio use is made of the parameter $\frac{A}{\mu\alpha}$ where

$$\mu = \frac{a_0 \cdot C}{4 \cdot s \cdot}$$

C = chord of wing

s = semi-span

using this parameter, we get

$$a_A = \frac{\pi}{2} \cdot A \cdot \left(\frac{A_1}{\mu\alpha}\right) \alpha \frac{a_0 \cdot C \cdot}{4 \cdot s \cdot} \quad .. \quad .. \quad .. \quad (6)$$

which when $a_0 = 2\pi x$ resolves to

$$a_A = \frac{\pi^2}{4} \cdot A \cdot \frac{c}{s} \cdot x \cdot \left(\frac{A_1}{\mu\alpha}\right) \cdot \alpha \cdot$$

but for a parallel wing $\frac{2s}{C} = A$ therefore when $\alpha = 1.0$

$$a_A = \frac{\pi^2}{2} \left(\frac{A_1}{\mu\alpha}\right) \alpha \quad .. \quad .. \quad .. \quad .. \quad (7)$$

Similarly for the tapered wings, when $\frac{A}{a_0} = 1.0$

$$a_A = \frac{\pi}{2} \cdot A \cdot \left(\frac{A_1}{\alpha}\right) \alpha \quad .. \quad .. \quad .. \quad .. \quad (8)$$

The numerical values of $\frac{A_1}{\mu\alpha}$ are taken from page 147 of Glauert's book and reproduced in Table 1 together with the values of a_A determined by means of 7. A column is also included in the table showing values of

$$a_A = \frac{6.05 \ A}{A + 2} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (9)$$

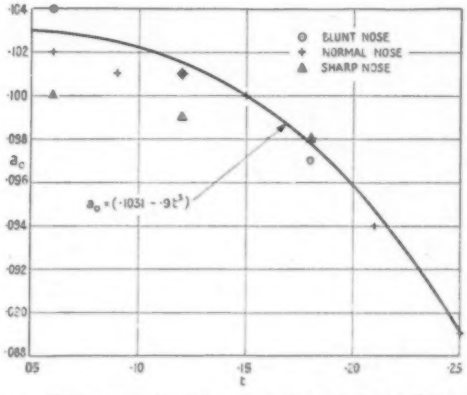

Fig. 4. Effect of nose radius on the slope of the lift curve. Symmetrical sections of infinite aspect ratio.

Over the practical range of aspect ratio and within the accuracy of the calculations this agrees with the theoretical values, so that generally, for rectangular wings of finite thickness, we may write

$$a_A = \frac{6.05 \cdot x \cdot A}{A + 2 \cdot x} \quad .. \quad .. \quad .. \quad .. \quad (10)$$

This shows, by comparison with 3, that the slope for the rectangular aerofoil is $\frac{6.05}{2\pi} = .96$ that of the elliptical aerofoil of the same thickness and aspect ratios.

It is argued from the above that for different plan forms the ratio between the slopes of the lift curves at equal aspect ratios will be practically constant, which leads to the expression:

$$a_0 = \frac{K_1 x A}{A + 2x} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (11)$$

Table 2 and Fig. 1 show how the value of K_1 varies with degrees of taper on a straight tapered wing. It will be noticed that for the rectangular wing ($\lambda = 1.0$) the value of K_1 is 6.02 instead of 6.05 given in 10. This is less than 1 per cent. and is attributable to slide-rule errors.

Another method of expressing the slope, favoured by the writer, is to replace K_1 by

$$2 \cdot \pi \cdot K_2 = K_1$$

when $a_A = K_2 \left(\frac{2 \cdot \pi \cdot x \cdot A}{A + 2 \cdot x}\right) \quad .. \quad .. \quad .. \quad (12)$

K_2 now becomes the multiplying factor for obtaining the slope from that of the elliptical wing of the same thickness and aspect ratios, which is given by the part within the brackets. Fig. 2 gives the variation of K_2 with taper showing a value of .958 for the rectangular wing when $\lambda = 1.0$.

To complete the investigation it is required to know how "x" varies with thickness ratio and/or the leading edge radius as suggested by Theodorsen (Ref. 2). Fig. 3 shows the variation with the thickness ratio when the

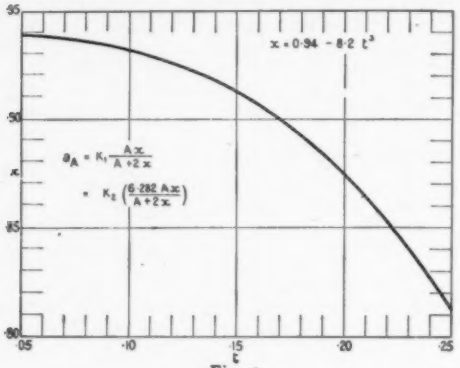

Fig. 5.

L.E. radius is $1.1 \cdot t^2$. The points are from the results of tests in the N.A.C.A. Variable Density Wind Tunnel (Ref. 3) at a Reynolds number of approximately full scale. The mean curve through the points (as drawn on the graph) follows the law

$$a_0 \text{ (per degree)} = 0.1031 - 0.9\,t^3 \quad .. \quad .. \quad (13)$$

from which

$$x = \frac{a_0}{.1097} = 0.94 - 8.2\,t^3 \quad .. \quad .. \quad .. \quad (14)$$

This is shown in Fig. 5.

The straight line drawn on Fig. 3 is the approximation suggested by Diehl (Ref. 4), which over the range of practical aerofoils agrees well with the mean curve through the points. In determining the slope of the lift curve for elliptical wings (see Fig. 6) the value of x . from Fig. 5 and the mean curve of Fig. 3 only have been used.

The effect of varying the L.E. radius is shown in Fig. 4. Theodorsen's theoretical conclusion—that the slope is

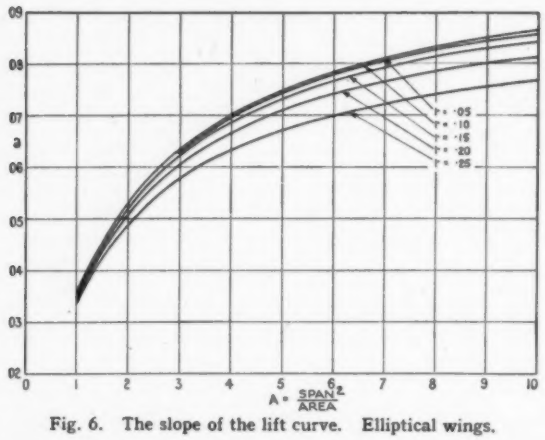

Fig. 6. The slope of the lift curve. Elliptical wings.

reduced with increased radius—does not seem to be confirmed. In fact, the actual points show that the smallest slope is with the sharp-nosed aerofoils, which may be fortuitous. Within the limits of experimental accuracy, the points confirm the mean curve of Fig. 3, showing that with a given thickness there is little or no variation of the slope of the lift curve with leading edge radius, and that the variation in slope is a function of thickness ratio only.

The slope of the lift curve for an elliptical wing of known thickness and aspect ratio is obtained directly from Fig. 6. For a rectangular or straight tapered wing the correction factor is given in Fig. 2. Alternatively, the slope may be calculated by means of equation 11 in conjunction with Figs. 2 and 5.

A tapered wing, having a large variation in the thickness-chord ratio between tip and root strictly requires special treatment. Referring to Fig. 7 a fictitious plan form is drawn by dividing the chord at any point by the appropriate value of x obtained from Fig. 5. The mean straight line drawn through the points obtained will give the fictitious ratio of tip chord to root chord and the value of K_2 corresponding to this value of λ is obtained from Fig. 2. The mean value of x is then the plan area of the wing divided by the fictitious area. Using these fictitious

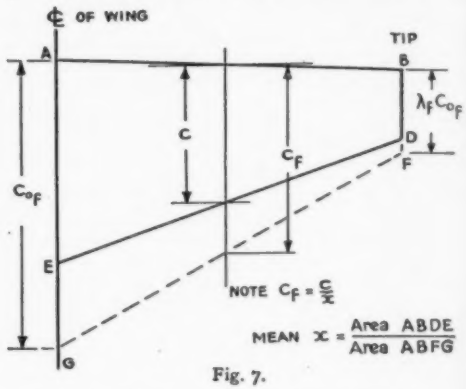

Fig. 7.

values the slope of the lift curve is then obtained by means of equation 11. Usually this refinement is not justified unless very thick wings (say 25 per cent. to 30 per cent.) are being used near the centre.

For convenience Tables 3 and 4 are added, giving the values from which the curves have been plotted.

TABLE 1.

RECTANGULAR AEROFOILS AT 1.0 RADIAN FROM ZERO-LIFT.

$\frac{A}{a_0}$	$\frac{A1}{\mu\alpha}$	When $a_0 = 2\pi$/Rad.		$\frac{6.05\,A}{A+2}$
		A	a_A	
·5	0.748	3.142	3.70	3.64
·75	0.859	4.713	4.24	4.24
1.0	0.928	6.284	4.59	4.59
1.25	0.976	7.855	4.82	4.83
1.5	1.011	9.426	5.00	4.99
1.75	1.038	10.997	5.13	5.12

TABLE 2.

TAPERED AEROFOILS $\frac{A}{a_0} = 1.0$

$\alpha = 1.0$ RADS. FROM ZERO-LIFT.

λ	A/α	$a\lambda$	$a\lambda\left(\frac{A+2}{2}\right)$ when $a_0 = 2\pi$
1.0	0.232	4.57	6.02
0.75	0.236	4.65	6.12
0.50	0.240	4.73	6.22
0.25	0.241	4.75	6.25
0	0.232	4.57	6.02

TABLE 3.

SLOPE OF LIFT CURVE FOR ELLIPTICAL WINGS.

(Slope given in terms of C_L and degrees.)

t	A=1.0	1.5	2.0	3.0	4.0	6.0	9.0	13.0
0.05	0.0358	0.0457	0.0532	0.0633	0.0701	0.0784	0.0853	0.0900
0.10	0.0357	0.0455	0.0529	0.0630	0.0698	0.0779	0.0847	0.0892
0.15	0.0354	0.0451	0.0523	0.0622	0.0687	0.0767	0.0832	0.0877
0.20	0.0348	0.0442	0.0511	0.0604	0.0667	0.0742	0.0803	0.0844
0.25	0.0339	0.0428	0.0491	0.0578	0.0633	0.0700	0.0755	0.0792

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